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ENVIRONMENTAL ANALYSIS ON WILSALL-CLYDE PARK 161 KV TRANSMISSION LINE

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SECTION I Introduction

The Department of Natural Resources and Conservation (Department) received an application from the Montana Power Company (MPC) on December 31, 1974 for permission to construct a 161 KV transmission line, hereafter referred to as the Wilsall-Clyde Park 161 KV line. A petition for waiver of the time requirements of Section 6 of the Utility Siting Act was also filed at that time. The proposed line would originate at the proposed site for a new substation located in Section 1, T2N, R8E and would extend approximately 11.4 miles south by southeast to the Clyde Park Substation located in Section 24, T1N, R9E. The applicant's preferred route and one alternative route for the proposed line are shown in Figure II-3, located in Section II of this report.

Section II contains an engineering analysis of the proposed line as well as a discussion of the existing transmission system in the Wilsall-Clyde Park area. A discussion of the need for the proposed line and an analysis of engineering alternatives which would fulfill the need are also presented. Sections III and IV of this report contain inventory and impact analyses of various aspects of the natural and cultural environments which would be affected by the proposed line. These analyses were conducted in a uniform study area shown on the various maps located in Sections III and IV. The Department's recommendations and mitigative measures which would reduce the environmental impact of the line are presented in Section V.

II. Engineering and Need Analysis

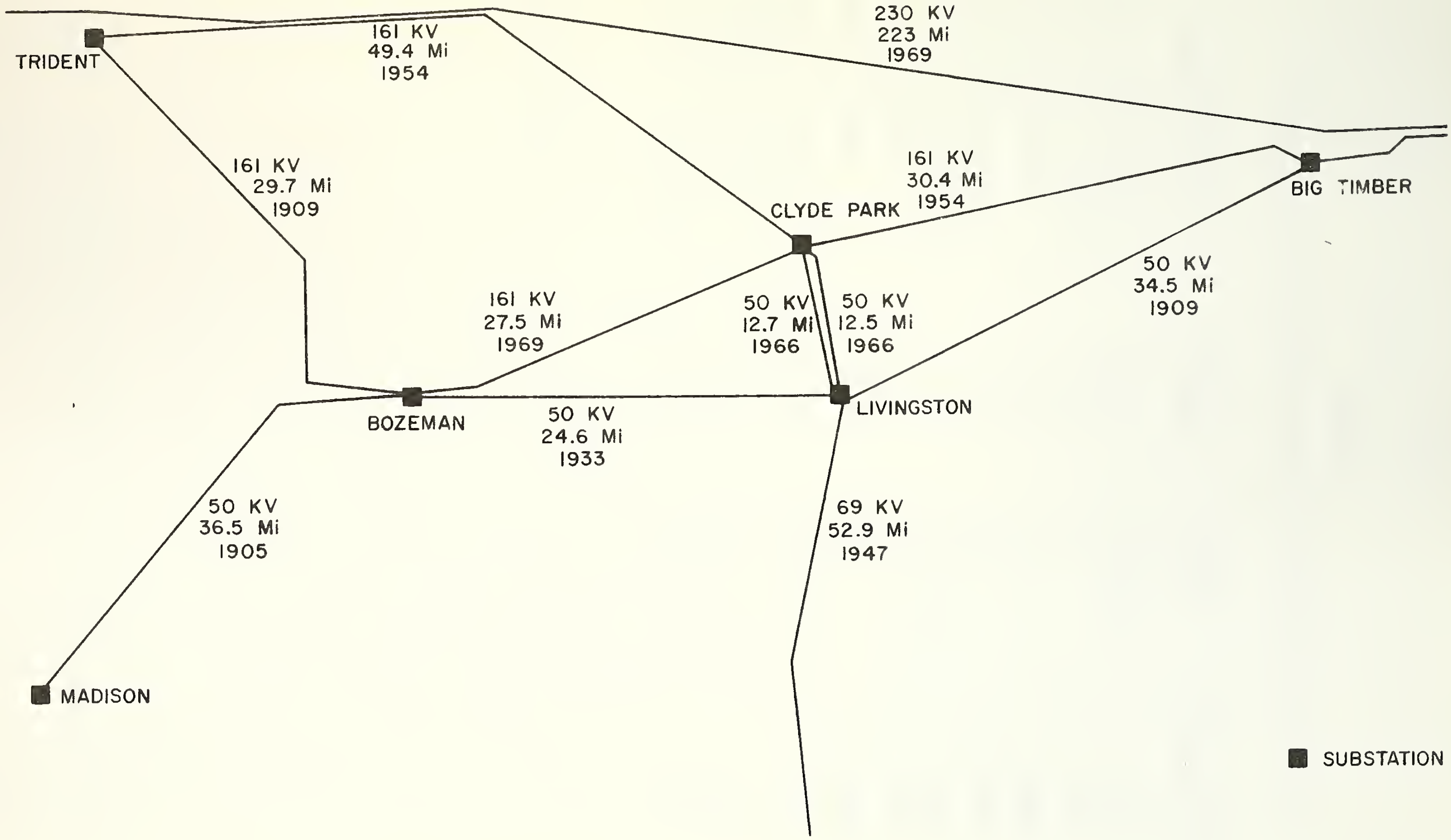
A. Existing System

The Clyde Park substation is one of the main sources supplying power to the Livingston and Bozeman substations. Other power sources are the Big Timber substation which services the Livingston area and the Madison and Trident substations which service the Bozeman area. These power sources are shown in Figure II-1. The Livingston substation also services Yellowstone Park.

Transmission lines in the area are also shown in Figure II-1 and are listed in Table II-1. All of these lines are connected so that the power flowing to each substation depends upon that substation's power demand conditions. These conditions change seasonally and daily at different time periods and are determined by a methodology known as "load flow analysis". The load flow analysis is conducted for a particular instant, always simulated, which assumes heavy power demand and stable loads at maximum power demand. The analysis shows how electrical power is flowing from the power plant through the transmission lines to the load area where the power is used. Examples of load flow analyses are given in Appendixes A, B, C and D.

B. Historical Load Pattern and Projected Load

Figure II-2 shows the peak load supplied to the Bozeman-Livingston-Gardiner area by the Clyde Park and Big Timber transmission substations from 1963 to 1974 and the applicant's peak load projections for 1975 and 1976. The applicant has conducted load flow analyses using the 1976 projected load which have raised questions concerning the future quality and reliability of electric service in the area.



CLYDE PARK SUBSTATION AND EXISTING TRANSMISSION SYSTEM

SOURCE MPC 1974

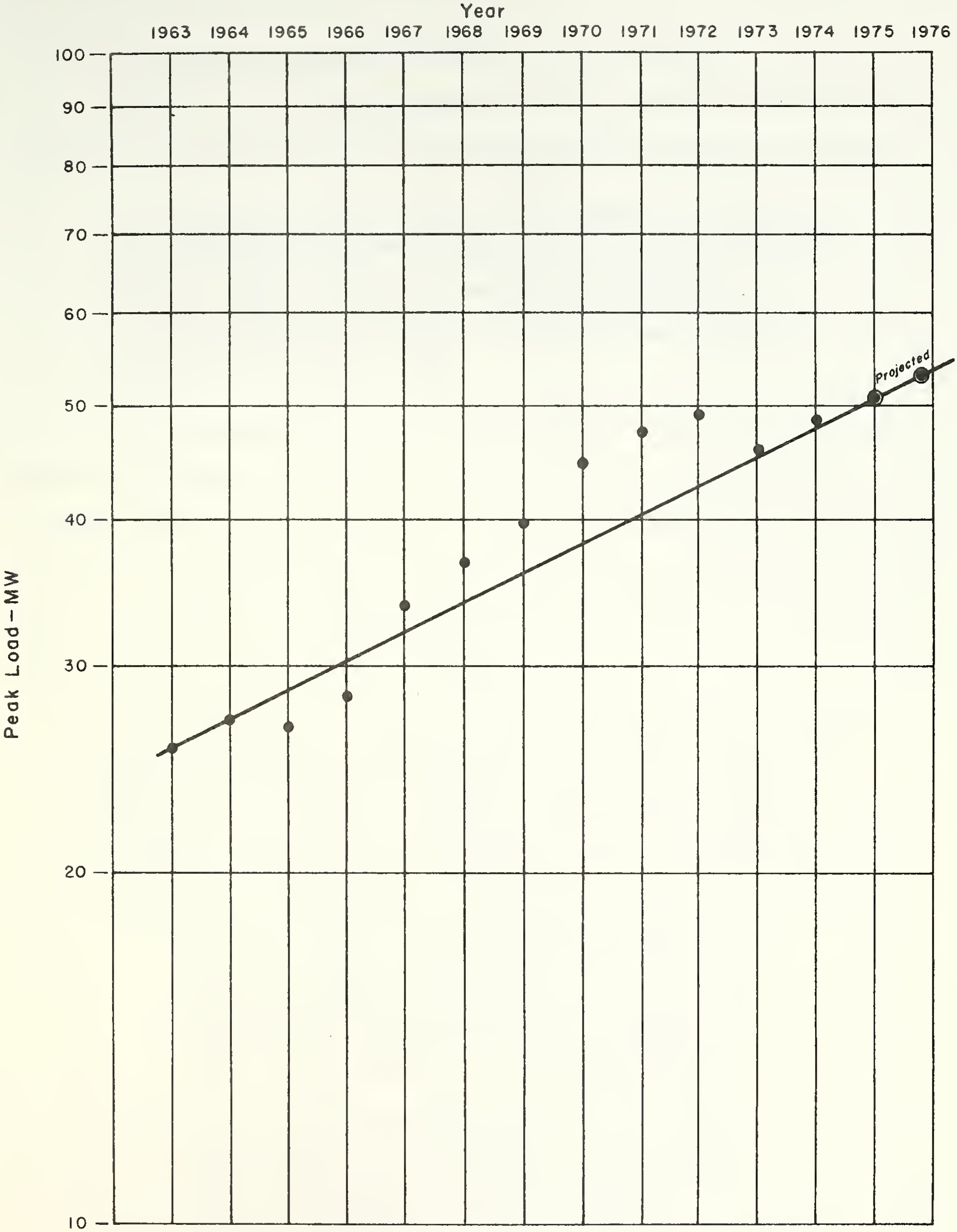
Figure II-1

TABLE II-1

Existing Transmission System of the Wilsall-Clyde Park Study Area

Transmission Line	Voltage	Length	Year of Completion
Clyde Park to Livingston	50 KV	12.5 mile	1954
Clyde Park to Livingston	50 KV	12.7 "	1966
Clyde Park to Bozeman	161 KV	27.5 "	1969
Clyde Park to Big Timber	161 KV	30.4	1954
Clyde Park to Three Forks	161 KV	49.4 "	1954
Bozeman to Madison	50 KV	36.5 "	1905
Bozeman to Trident	50 KV	29.7 "	1908 - 1910
Bozeman to Livingston	50 KV	24.5 "	1933
Livingston to Gardiner (Yellowstone Park)	69 KV	52.9 "	1941 - 1947
Livingston to Big Timber	50 KV	34.5 "	1909

Source: MPC 1974



Note I. Loads shown are winter peak loads.
REV. I. Note I added; 74 load added. (4-9-75)

SOURCE: MPC 1974

POWER SUPPLIED TO THE BOZEMAN-LIVINGSTON-GARDINER AREA FROM THE CLYDE PARK AND BIG TIMBER TRANSMISSION SUBSTATIONS

Figure II-2

C. Electric Service Regulations and Reliability

Montana law provides that the Public Service Commission is empowered to establish rules and standards for service as follows:

> The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage, or other conditions pertaining to the supply of the product or service rendered by any public utility, and prescribe reasonable regulations for examination and testing of such product or service and for the measurement thereof. (Section 70-112, R.C.M. 1947)

In accordance with the above statute, the Public Service Commission adopted the following rule concerning maintenance of voltage levels: (Electric Service Regulations and Schedules prescribed by the Public Service Commission for MPC, effective Jan. 1, 1961, revised Dec. 8, 1967; adopted into the Montana Administrative Code in Section 38-2.14 (1) - S1400)

> Rule 8-5 Voltages --- Utility shall adopt nominal standard, alternating current voltages for its entire distribution system, or for each of the several areas into which the system may be divided. Utility shall, upon request from Commission, customer, or prospective customer, furnish statement of the nominal standard voltages for any specific area. The voltages shall be maintained at a reasonably constant value at any customer's point of delivery, as follows:
>
> a) For service to residential and commercial customers, the voltage variation shall not exceed six per cent plux or minus from the nominal standards within the corporate boundaries of cities and towns having a population of 2500 or more, nor eight per cent plus or minus in all other places.
>
> b) For service rendered primarily for power purposes and for other service rendered under power rate schedules, the voltage shall not exceed ten per cent plus or minus from the nominal standard voltages.
>
> c) A greater variation of voltage than specified above may be allowed when contracts of rate schedules so provide, when service is supplied directly from a transmission line, or in areas where customers are widely scattered, or the revenue does not justify close voltage regulation.

In order to maintain customer service voltage within a ±6% or ±8% variation of the standard nominal transmission line voltage, some type of regulation which is not provided by law is needed. Therefore, each utility company adopts its own regulations. Usually the utility company allows up to 8% voltage drop (up to 15% in some cases) in the transmission system under normal conditions. Regulators are used to control voltage drop and return voltage to normal levels, but these devices have a practical limit of application.

When electrical load increases, the voltage drop on the transmission line also increases. Additional lines may be required to provide adequate service or the entire existing system may need upgrading. When a fault occurs on one line of an interconnected system of lines, the rest of the lines have to carry extra load, and in that situation some lines may exceed the voltage drop limitation. This creates a condition of poor service reliability which the utility companies may be required to correct or prevent. The load flow analysis for the Wilsall to Clyde Park transmission line application shows that this type of voltage problem has occurred (see Table II-2).

As indicated by the information in Table II-2 (see Appendixes A and B for details), the voltage drop problem in the Yellowstone Park area must be corrected in order to insure that customer voltage levels stay within the limit of ±8%. The Montana Power Company has applied for three new transmission lines in the area, including the Wilsall-Clyde Park 161 KV line, in order to correct the problem. Results of a load flow analysis with the Wilsall-Clyde Park line added are given in Table II-3.

TABLE II-2

Load Condition	Transmission line voltage levels				
	at Clyde Park	at Bozeman	at Livingston	at Gardiner	at Yellowstone
Normal operation of existing system using 1976 heavy electrical demand figures	2.7% drop (.973)	1.2% drop (.988)	5% drop (.95)	12% drop (.877)	19% drop (.807)
Clyde Park-Big Timber 161 KV line out of service, and using 1976 heavy electrical demand figures	12.1% drop (.879)	12.3% drop (.877)	16.5% drop (.835)	40% drop (.596)	49.1% drop (.459)

Source: MPC, 1975

TABLE II-3

Voltage Levels With Addition of Wilsall-Clyde Park 161 KV Line*

Load Condition	Transmission line voltage level				
	at Clyde Park	at Bozeman	at Livingston	at Gardiner	at Yellowstone
Normal operation of existing system using 1976 heavy electrical demand figures	Rise 2.2% (1.022)	Rise 3.2% (1.32)	Rise 1% (1.01)	drop 3.1% (.969)	drop 9.1% (.909)
Clyde Park-Big Timber 161 KV line out of service using 1976 heavy electrical demand figures	Rise 0.8% (1.008)	Rise 1.8% (1.018)	drop .04% (.996)	drop 5.2% (948)	drop 11.3% (887)

* Further details are provided in Appendixes C and D.

Source: MPC, 1975

Table II-3 indicates that with the addition of the proposed Wilsall-Clyde Park line, the Yellowstone Park area will still experience voltage drop problems during an outage on the Clyde Park-Big Timber 161 KV line. The Wilsall-Clyde Park line will help improve voltage levels in all areas, but the Gardiner and Yellowstone area voltage drop problems need further consideration. One of the additional lines MPC has applied for is the Clyde Park-Dillon 161 KV transmission line. Further examination and analysis of the voltage drop problem will be presented in the Department's study of this application.

Outage data for the Clyde Park-Big Timber 161 KV line from 1970 through 1974 is presented in Table II-4.

D. Alternatives

This subsection presents a discussion of adequate voltage level services and practical engineering alternatives which can correct the voltage drop problems described above.

1. Up-grading the existing system

There is no existing system which could be upgraded instead of constructing the proposed line. Therefore, this may not be considered an alternative.

2. Addition of transmission lines at higher voltage levels

Voltage drop problems can be solved by the addition of new transmission lines. The use of a higher voltage level reduces current flow in the conductors and effects lower voltage drop and leww power loss. The Bozeman, Livingston, and Gardiner areas

TABLE II-4

Clyde Park - Billings 161 KV Transmission Line Outages
1970 - 1974

A. Voluntary Outages

Date	Duration (Hours : Minutes)
Feb. 1970 to May 1970	39 outages occurred with average duration of 8:00 for tightening hardware and installing vibration dampers.
10- 8-70	0:23
12- 4-70	8:01
12- 7-70	8:05
12-17-70	3:37
3-16-71	10:32
7-15-71	6:24
7-16-71	5:13
9-14-71	12:47
2-23-72	0:06
2-24-72	8:04
2-25-72	8:04
2-29-72	5:13
3-23-72	1:22
11- 6-72	4:28
1-18-73	2:18
5-24-73	1:38
9-11-73	3:59

B. Involuntary Outages

Date	Duration (Hours : Minutes)
3-24-70	0:06
3-26-70	0:05
12- 9-70	0:03
1-28-71	0:03
2-17-71	0:06
4- 1-71	0:05
7- 2-71	0.03
9-14-71	0:06
9-14-71	0:40
3-13-72	0:25
4- 3-72	1:10
8- 4-72	0:18
8- 7-72	0:12
11-19-72	1:18
1-31-73	0:17
4-18-73	1:00
4-19-73	36:20
4-26-73	0:21
6-11-73	0:06
6-18-73	0:06
8-22-73	0:35
10- 9-73	0:05
10-31-73	0:04
8-20-74	0:03

Source: MPC 1975

presently have 69 KV and/or 50 KV transmission voltage level service. Voltage levels of 161 KV or 230 KV would sufficiently increase voltage and also handle future electrical load growth. The selection of voltage level is determined by the voltage level available in the grid system as well as various economic analyses. According to the applicant, 161 KV voltage level is more suitable than 230 KV for the proposed line.

E. Description of Proposed Facility and Specifications (applicant's preferred alternative)

The applicant's proposed centerline location, substation site and alternative sites are shown in Figure II-3. Technical and design data supplied by the applicant are listed below.

Length of the line: 11.4 miles

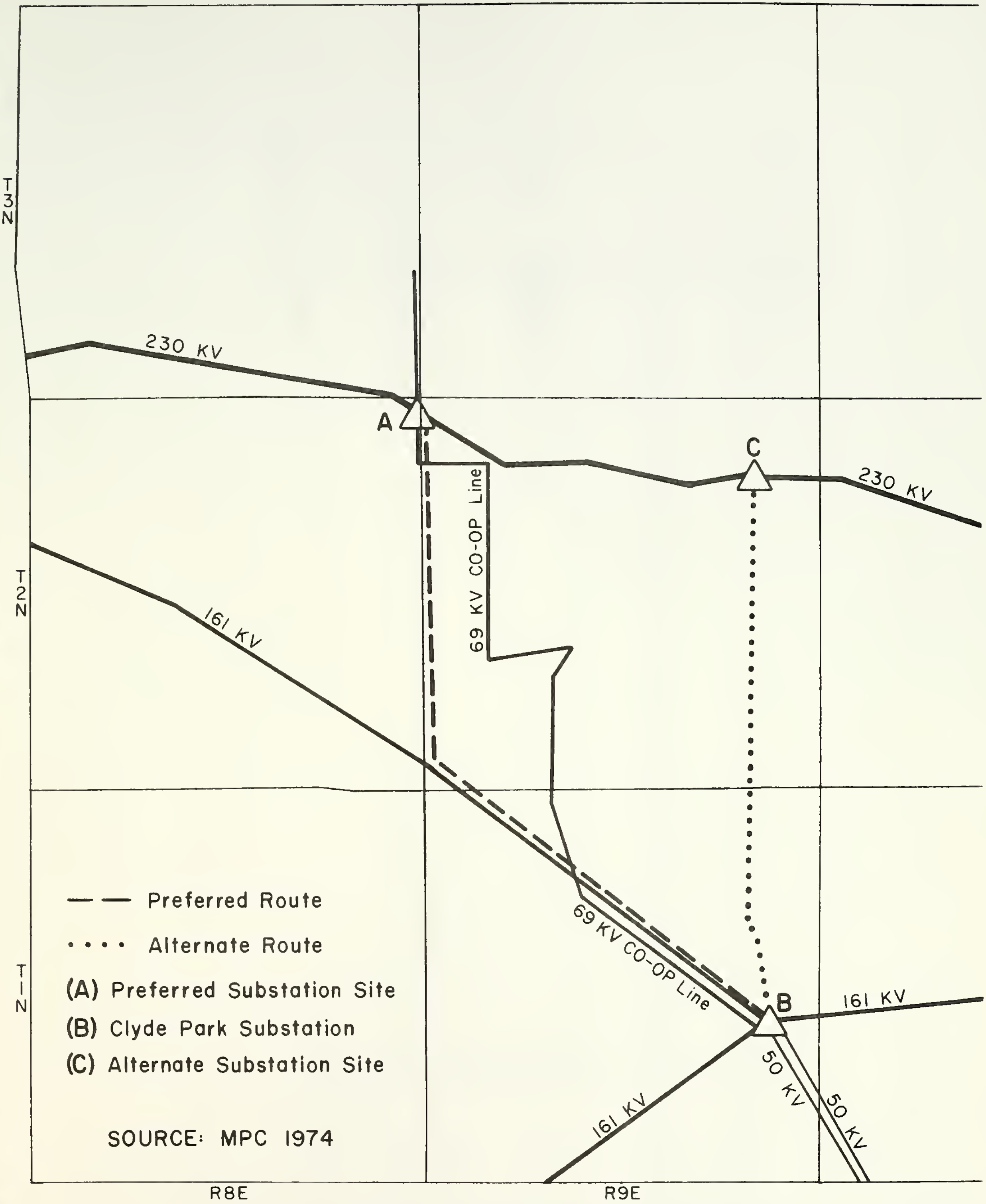
Voltage level: 161 KV (161,000 volts)

Transmission line poles:

- "H" type structures (see Figure II-4)
- Single pole structures (see Figure II-5)
- Foundation: approximately 8'
- No. of poles per mile: 7 or 8

Transmission line:

- Conductor size: 0.927" (556.5 MCM-ACSR)
- Minimum Ground Clearance: 28'
- Insulators: 6 or 7, 10" diameter
- Ground wires: two, 3/8" diameter, high strength steel

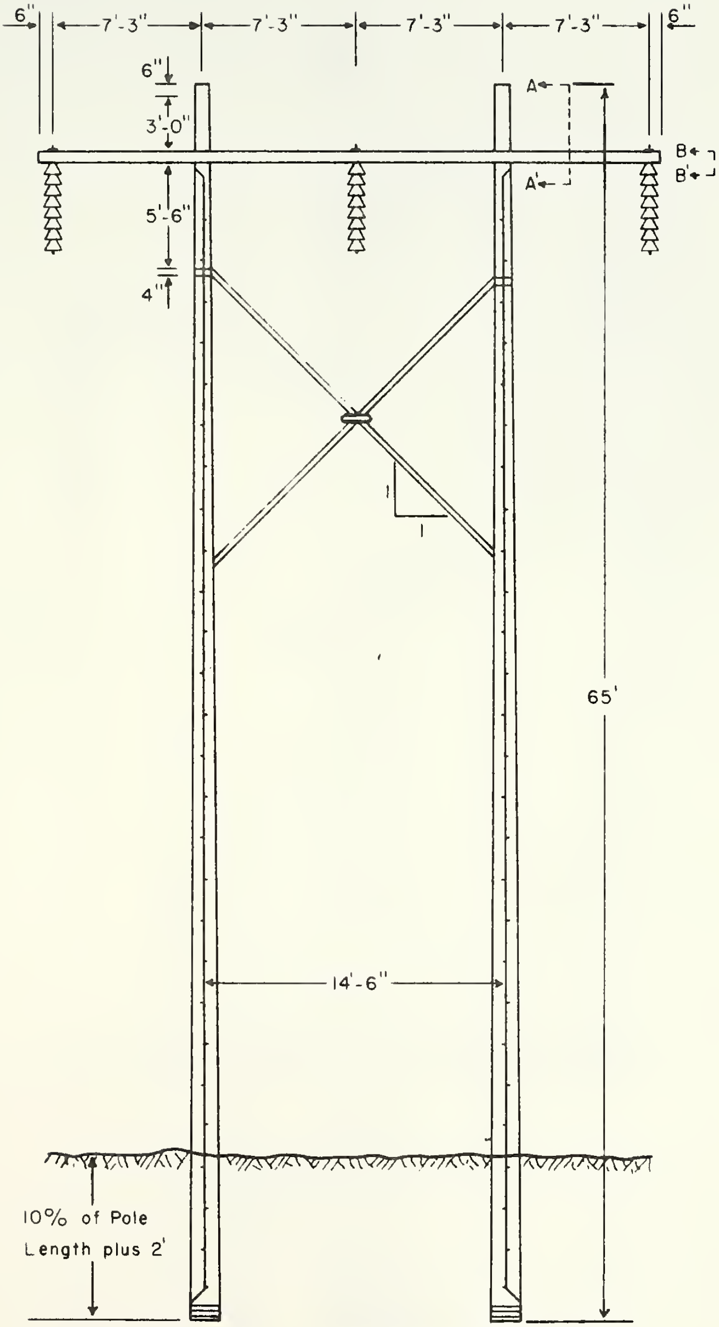


SOURCE: MPC 1974

Clyde Park–Wilsall 161 KV Transmission Line

PREFERRED & ALTERNATE ROUTES

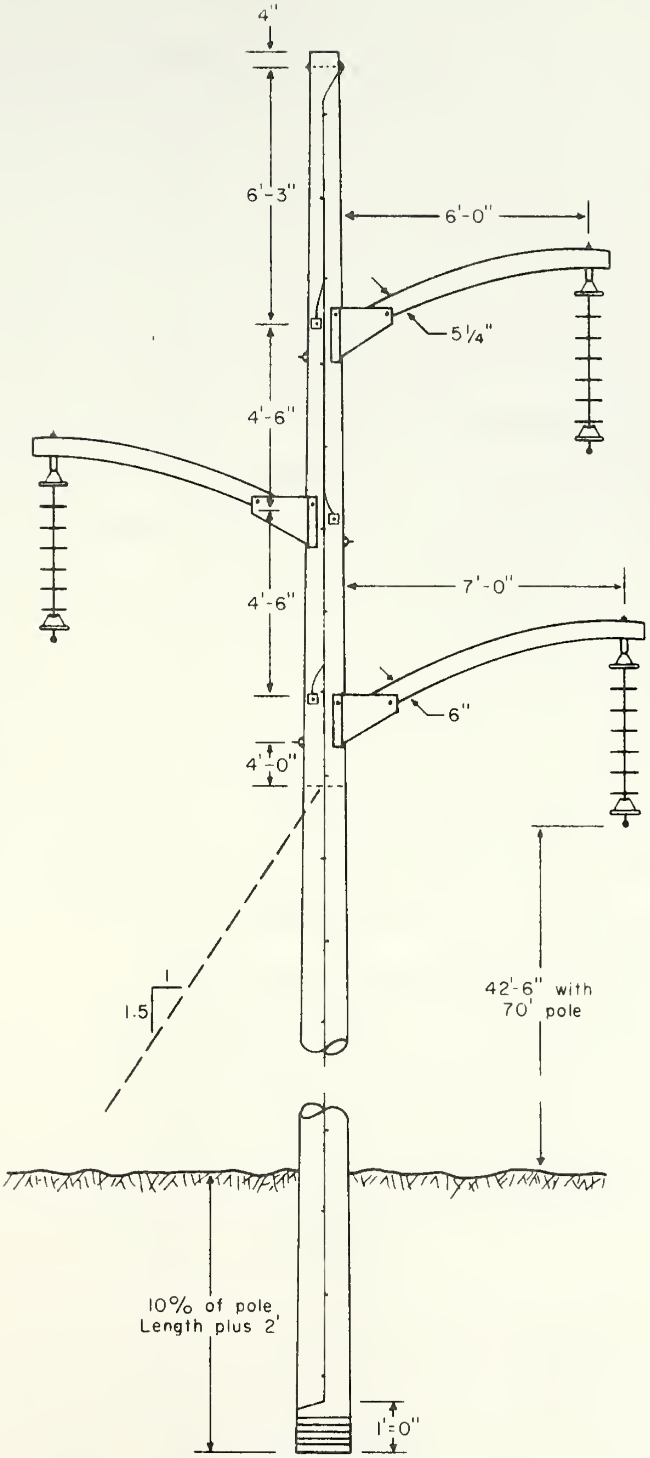
Figure II-3



161 KV LINE SINGLE CIRCUIT STRUCTURE

SOURCE: MPC 1974

Figure II-4



161 KV TANGENT-SINGLE CIRCUIT

SOURCE: MPC 1974

Figure II-5

Section III. Biophysical Inventory and Impacts

A. GEOLOGY

1. Inventory

a. Physiography

The proposed transmission line would lie in the Shields River Valley. Wilsall and Clyde Park are situated near the river and are centrally located in the valley at an elevation of about 5000 feet above sea level. The Shields River originates in the northern part of the Crazy Mountains and flows south into the Yellowstone River at a point approximately five miles northeast of Livingston, Montana. Numerous streams cross the valley to enter the Shields River from the Crazy and Bridger mountain ranges. The valley is not well defined by a broad floor or by abruptly rising mountain sides as are many valleys in western Montana. The crest of the Bridger Range, with peaks over 9000 feet, trends parallel to the axis of the valley and lies about 15 miles west-southwest of the river. Some foothills of the Bridger Range extend well into the valley. The Crazy Mountains lie about ten miles east-northeast of the Shields River with a number of peaks over 10,000 feet and one (Crazy Peak) reaching 11,230 feet. As with the western side, the eastern edge of the valley is not particularly prominent.

The study area can be separated into three physiographic units: 1) the Shields River floodplain, 2) the rolling uplands west of the Shields River, and 3) the uplands east of the Shields River dominated by the remains of a number of old erosion surfaces.

The Shields River meanders across its floodplain which averages less than one-half mile in width in the study area. Although the floodplain comprises only a small part of the total study area, its linearity makes it a significant physiographic unit in the consideration of the proposed transmission line. Relief of the floodplain is much less than that of the surrounding uplands.

The uplands east of the Shields River floodplain are characterized by a series of old erosion surfaces (pediments) which were formed on bedrock (Livingston Formation and possibly some igneous rock) and are veneered by gravel. These surfaces slope away from the Crazy Mountains toward the Shields River at a gradient of 100-150 feet per mile. Cottonwood Bench is one of the best examples of these discontinuous, partially destroyed surfaces. Some surfaces are separated by narrow stream valleys and by lower level surfaces. Bluffs as high as 200 feet terminate these surfaces along the Shields River and its tributaries.

West of the Shields River, the uplands are not composed of erosional surfaces. Instead, this area is characterized by rolling hills and occasional prominent outcrops of bedrock (see Figure III-2). Small-scale buttes and cuestas are common in the northwest part of the study area. Battle Ridge, which is composed of resistant sedimentary rock, is a prominent feature extending northeast from the Bridger Range to Wilsall.

The uplands on both sides of the Shields River floodplain have hills and ridges which owe their presence to the igneous bodies (dikes, lopoliths, sills) which intruded the Livingston Formation.

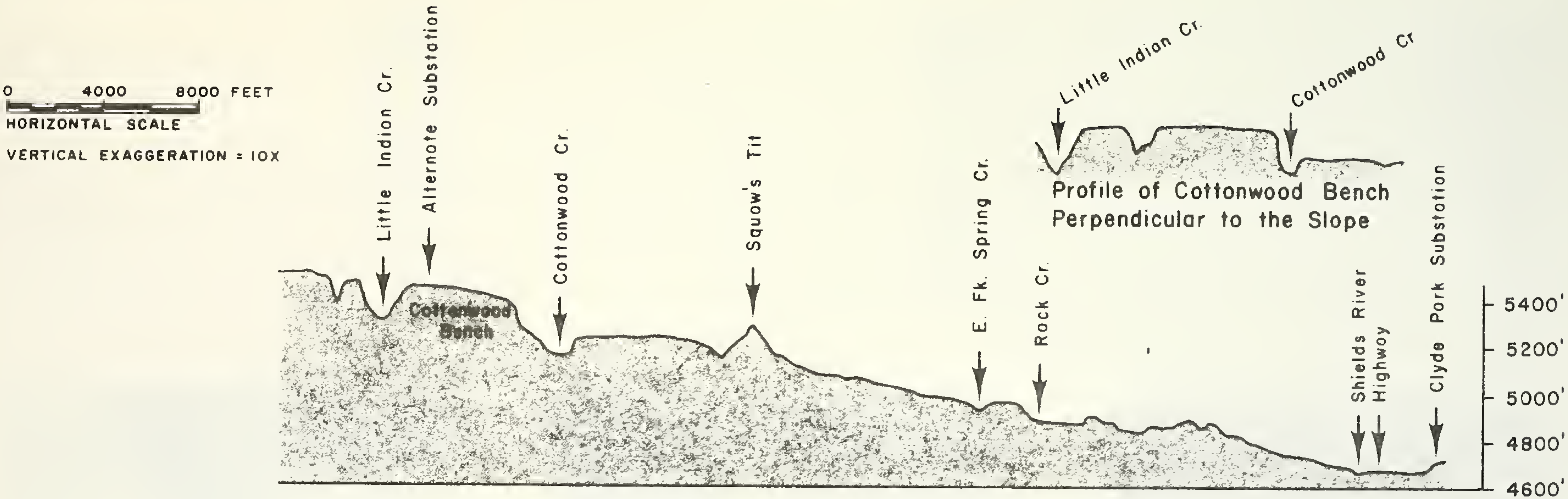
Figure III-1 shows three topographic profiles which are typical of the two upland areas. Cottonwood Bench appears flatter in one profile than the other, a result of traversing it perpendicular to the slope. It should be noted that the profiles closely follow the applicant's preferred and alternative routes for the proposed transmission line.

b. Rock Types

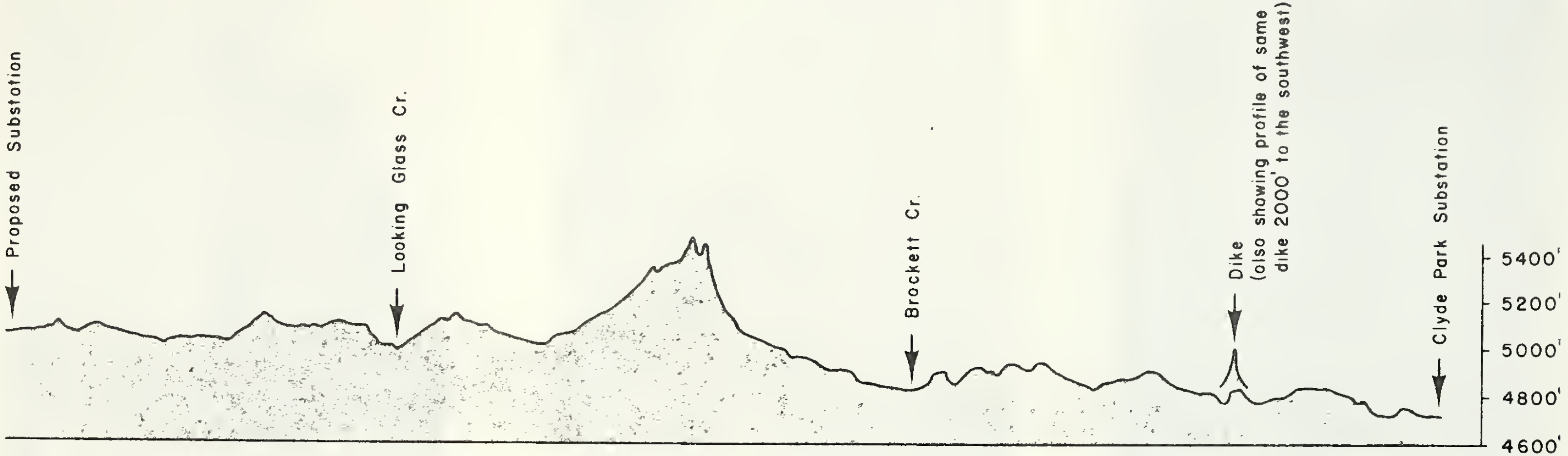
The entire study area is underlain by the Livingston Formation of Upper Cretaceous and Paleocene age. This formation was intruded by magma during the Eocene which formed a number of dikes and other small igneous bodies (Bluemle 1962) (see Figure III-3). A series of late Tertiary and Quaternary erosion surfaces east of the Shields River are veneered by a layer of stream gravel (see Figure III-4), and Quaternary alluvium underlies the floodplain of the Shields River and some of its tributaries.

i. Livingston Formation

The Livingston Formation occurs in a large area to the east and northeast of the Bridger Range, surrounding the entire Crazy Mountain Range. The Crazy Basin was receiving sediments from nearby uplands from late Cretaceous to early Tertiary time. The greatest thickness of the Livingston Formation, estimated to be at least 14,000 feet, occurs just east of the Bridger Range (McMannis 1957). McMannis (1957) divided the formation into five units. The lowermost unit consists of about 4500 feet of shale, sandstone, conglomerate, and some nodular limestone. The second unit is finer grained and is composed of 3500 feet of sandstone, shale, and bentonitic clay beds. This unit is generally non-



Profile of Applicant's Alternate Transmission Line Route



Profile of Applicant's Preferred Transmission Line Route

SELECTED TOPOGRAPHIC PROFILES WITHIN THE STUDY AREA

Figure III-1

Figure III-2: Small-scale prominent outcrop of the Livingston Formation

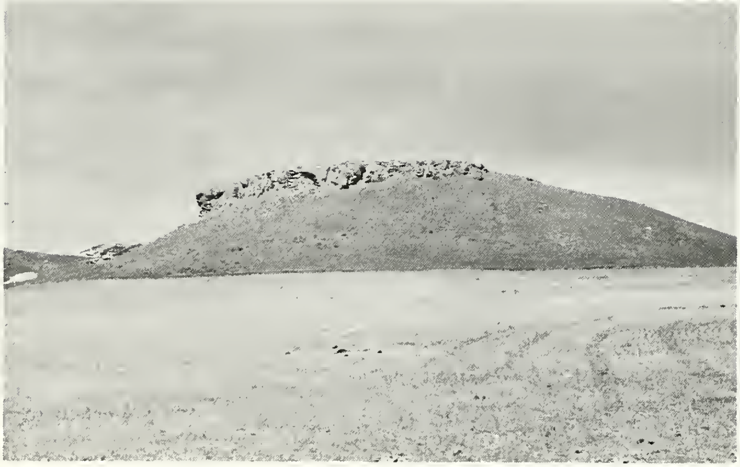


Figure III-3: Small igneous dike along applicant's preferred route

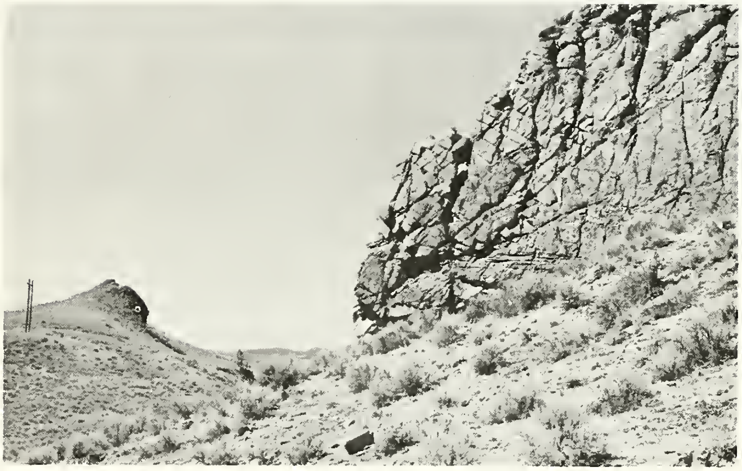
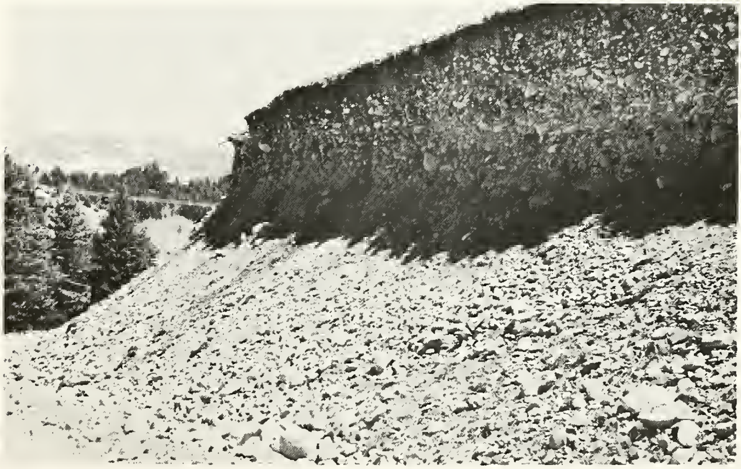


Figure III-4: Gravel veneer underlying pediment surface



resistant. About 3500 feet of sandstone and conglomerate forms the third of McMannis's units. Several types of igneous rocks, Mesozoic and Paleozoic sedimentary rocks, and Precambrian igneous and metamorphic rocks form the conglomerate. This unit is more resistant than the others and supports Battle Ridge which terminates just north of Wilsall. Most of the study area is underlain by the two upper units. Two thousand feet of sandstone, containing some conglomerate similar to that occurring in the third unit, forms much of the landscape south and southwest of Wilsall. The fifth and uppermost unit is about 1000 feet thick and consists of conglomerate similar to that found in the lower units. This unit is restricted in outcrop to the axis of a syncline southeast of Battle Ridge. The upper three units are believed to be Paleocene in age (McMannis 1957) or equivalent to the Fort Union Formation farther east.

ii. Igneous Intrusives

The Crazy Mountains are a result of differential erosion, unlike the ranges farther west in Montana (Bluemle 1962). The Livingston Formation is less resistant to erosion than the igneous rocks intruded into it (Bluemle 1962). The igneous bodies consist of a large intrusive mass in the middle of the mountain range with scores of dikes radiating from the center. Other intrusive bodies of various sizes and forms also surround the main mass. Although the major intrusive bodies, including most of the exposed dikes, lie outside of the study area, a few do occur within its boundaries (see Figure III-3). The intrusives generally form topographic highs where they crop out.

iii. Veneering Gravels

The erosion surfaces (pediments) on the east side of the Shield's River are covered by a veneer of gravel containing boulders up to two feet in diameter (see Figure III-4). The thickness of the veneer varies from several feet to tens of feet. Bluemle (1962) concludes that the pediments were formed by laterally shifting graded streams which planed the bedrock (Livingston Formation and possibly some igneous bodies) and deposited the gravel. Bluemle divides the present surfaces (the remains of larger and once more continuous surfaces) into four groups. The highest, and therefore the oldest, is assigned an age of late Pliocene or early Pleistocene. The second, third, and fourth groups are assigned to early to mid-Pleistocene, early Wisconsin, and "intra-Wisconsin", respectively. The surfaces within the study area are included in the third and fourth groups. Cottonwood Bench and some surfaces east and southeast of Clyde Park are considered to be "early Wisconsin", while lower surfaces such as the one adjacent to and just south of Cottonwood Creek are "intra-Wisconsin" in age.

The veneering gravels are (or have been) quarried for use as aggregate as local need arises.

c. Structure

The Livingston formation has been deformed by a number of folds in and around the study area. As a result of this folding, the strata are generally inclined. Small-scale cuestas occur frequently in some parts of the area, especially west of the Shields River. The lack of particularly resistant strata within most of the Livingston Formation results in a lack of large cuestas and related

forms being developed on the sedimentary rocks. (Battle Ridge is an exception to this generality.) However, a number of ridges are supported by resistant igneous rock bodies. Vertical dikes and gently dipping concordant bodies (sills, lopoliths, etc.) occur within the study area

No major faults are known to exist in the area, although small ones associated with the deformation of the sedimentary rocks are probably quite common. Major late Tertiary to Recent faults involved in raising the present mountain ranges do exist to the south and west in the Absaroka-Beartooth, Gallatin, and Bridger Ranges.

d. Geologic Hazards

A number of potential geologic hazards to the construction and operation of a transmission line in the study area should be considered.

i. Seismicity

The study area lies at the edge of the intermountain seismic belt (Montana DNRC 1974) and therefore, is likely to be shaken by earthquakes occurring in western Montana and northern Wyoming. None of the outstanding earthquakes in Montana have occurred as far east as the study area, and the absence of known, large Recent faults in the study area reduces the expectation of a major earthquake occurring. The shaking from earthquakes occurring as near as the Bridger Range or in the Livingston area could initiate rock falls, landslides, or similar phenomena. If engineering consideration is given to potential hazards which could be triggered by a distant earthquake,

the seismic risk to the proposed transmission line is small.

ii. Rockfall

There are several places within the study area where slopes are steep enough to present a rockfall hazard. Since these areas are small and easily avoidable, engineering considerations can eliminate this hazard.

iii. Landslides

Landslides occur naturally on some steep slopes in the area, particularly where streams are undercutting slopes. The edges of the pediment surfaces in particular should be evaluated prior to traversing with a road or setting of poles. Careful pole siting should generally eliminate this hazard.

iv. Flood Hazards

The Shields River and its tributaries are subject to occasional flooding. If support structures must be placed on the floodplains, proper provisions should be made to mitigate damage from flooding.

v. Difficulty of Excavation

Some of the conglomerate within the Livingston Formation, igneous rocks, and the veneering gravel of the pediment surfaces could cause difficulty in the placement of poles. The unconsolidated cobbles and boulders of the pediment veneer could present serious problems to the augering of holes, depending upon the equipment used. The igneous rocks occur at the surface in places and appear to be quite solid where examined. Except on the pediment surfaces, careful siting of the towers could reduce the amount of excavation required in these difficult rocks.

2. Impacts

The proposed route for this transmission line follows existing facilities and roads for much of its distance. Therefore, access is either immediately available or available over areas already crossed by lines for most of the route. The previous discussion of geologic hazards illustrates that most of the hazards, and therefore impacts, can be greatly reduced or entirely eliminated by an awareness of the hazards and subsequent consideration of them in pole siting. The ridge crossed by the preferred route near Brackett Creek poses the greatest problem. A rise of 400 feet occurs over a horizontal distance of about 2000 feet, a 20% average slope, on the southern side of the ridge. Careful planning can avoid the necessity of crossing the steepest part of the ridge face with an access road. Excavation problems may be encountered at the ridge crest, however.

B. SOILS

1. General Discussion

An intensive inventory and study of the soil resource is fundamental to the evaluation of impacts associated with transmission line siting. This resource controls many of the primary and secondary impacts of construction activities including responses affecting land use and economics. The soil resource is the most important factor to be analyzed from the standpoint of the natural system and is a basis for analyses of subsequent economic impacts.

The soil resource controls many of the characteristics of natural ecosystems, such as the numbers and kinds of organisms, their responses to changed conditions, and inherent productivity. A detailed analysis of this resource, when integrated with the highest level of plant ecology and distribution studies, is the best method of describing the potential vegetation that an area can support. The soil system and plant community have developed concommitantly. Plant communities often are drastically altered by man's activities, but unless management has been totally misdirected, the soil system will usually retain enough of its original characteristics to be correlated with similar soils supporting known climax plant communities in a given area. The productivity and composition of the plants found in an area are directly related to the nature of the soil system. It further follows that there is a constant relationship between the soil resource and the kinds and numbers of animals found in an area. Large segments of the integrated energy flow characterizing the soil-plant-animal components of an ecosystem can be altered by man. These relationships must be

carefully evaluated in planning and management activities in an attempt to lessen or mitigate man's impact on the natural system.

The soil is a dominant factor in the development of integrated resource management techniques and methodologies. Any management scheme must carefully consider the nature of the soil system if it is to succeed in either the short or long term. Agricultural systems and productivity are developed with respect to the depth, fertility, waterholding capacity, etc. of the soil system. Range management techniques and determination of the number of grazing animals which can be supported are basically controlled by characteristics of the soil. Timber harvest methods and basic levels of productivity are correlated with the type of underlying soils.

Soils are defined in many ways, but the concept of a three dimensional, naturally occurring body which is capable of supporting the growth of higher plants is basic. Soils are characterized by both living and non-living components which are important to management activities. The physical, non-living portion of the soil is decomposed minerals or minerals which have been resynthesized during the soil formation process. The smallest of these particles are clays, and they have great control over the characteristics and management of the soil system. The other two particle sizes include the silts, which are slightly larger than the clays, and the sands. Particles larger than 2mm. in diameter are very important in the management of the soils in the study area. The soils found on the outwash terraces east of the Shields River are underlain with large amounts of gravels, stones and cobbles. In some instances these particles are found within or near the surface

and determine the uses and management that are possible. An example of this control is the limited use that can be made of very gravelly and cobbly soils.

The soils in the study area have developed over thousands of years through the actions of living systems on parent material. Climate and relief are additional independent variables of soil formation. In the intermountain valleys of the study area, the nature of the parent material is a strong determinant of the characteristics of the soil developing on a site. Climate is important, but it is not such a strong force as in hotter and higher moisture environs of other portions of the world. The primary factor to consider when evaluating or managing soil resources is the very long periods of time involved in their development compared with the short periods of time required for their destruction. It is literally impossible to resynthesize a soil once it has been destroyed.

2. Soils of the Study Area

Four major soil groups are found in the study area (see accompanying Figures III-5 through III-8). These include the soils found in the floodplains which are basically very young (i.e., have developed and still are developing in recent sediments and reflect very little in situ formation). These soils frequently have dark colored surface horizons and are generally quite fertile and productive. Their primary limitation is susceptibility to flooding. In some instances, restricted drainage and the general climate of the area limit the development of more intensive types of agricultural crops. The soils found east of the Shields River on the extensive outwash terraces are among the most productive

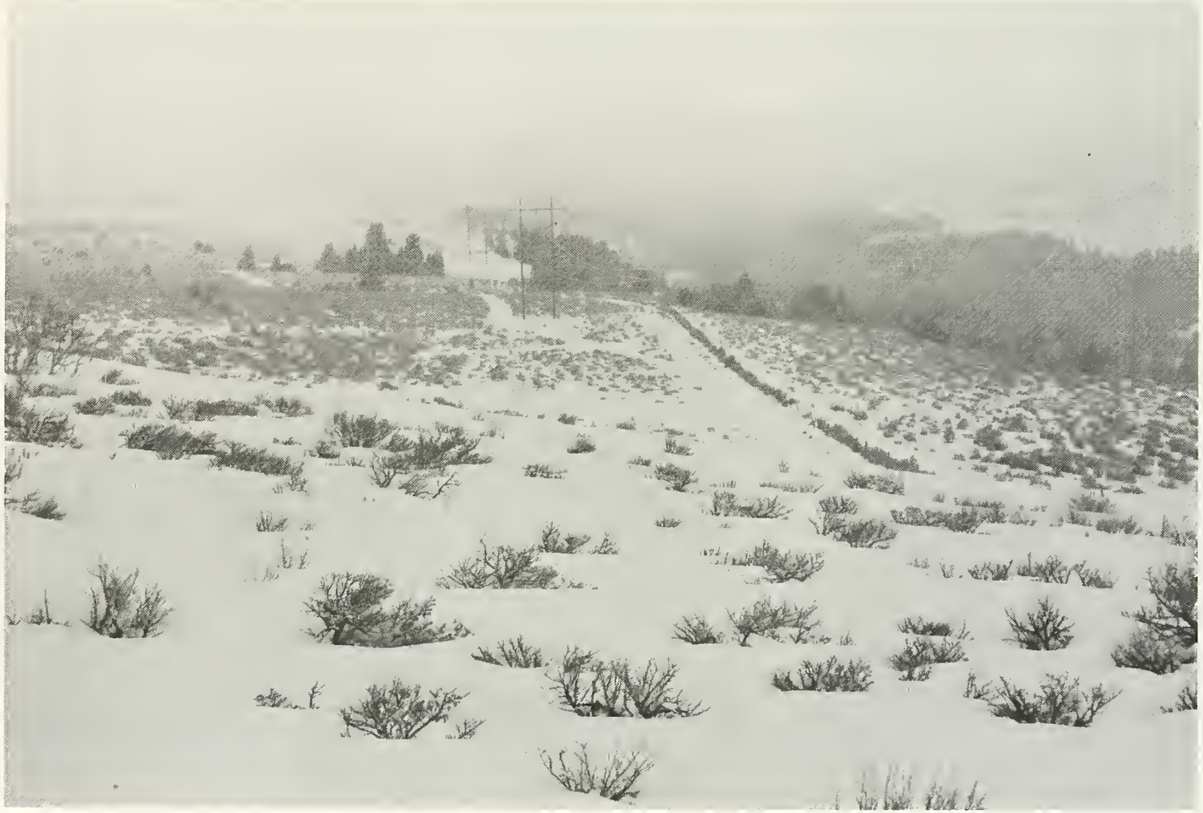


Figure III-5 Existing transmission line crossing the upper portion of the Cottonwood Bench northeast of Clyde Park, Montana. The sagebrush in the foreground is not part of the potential vegetation of the area.

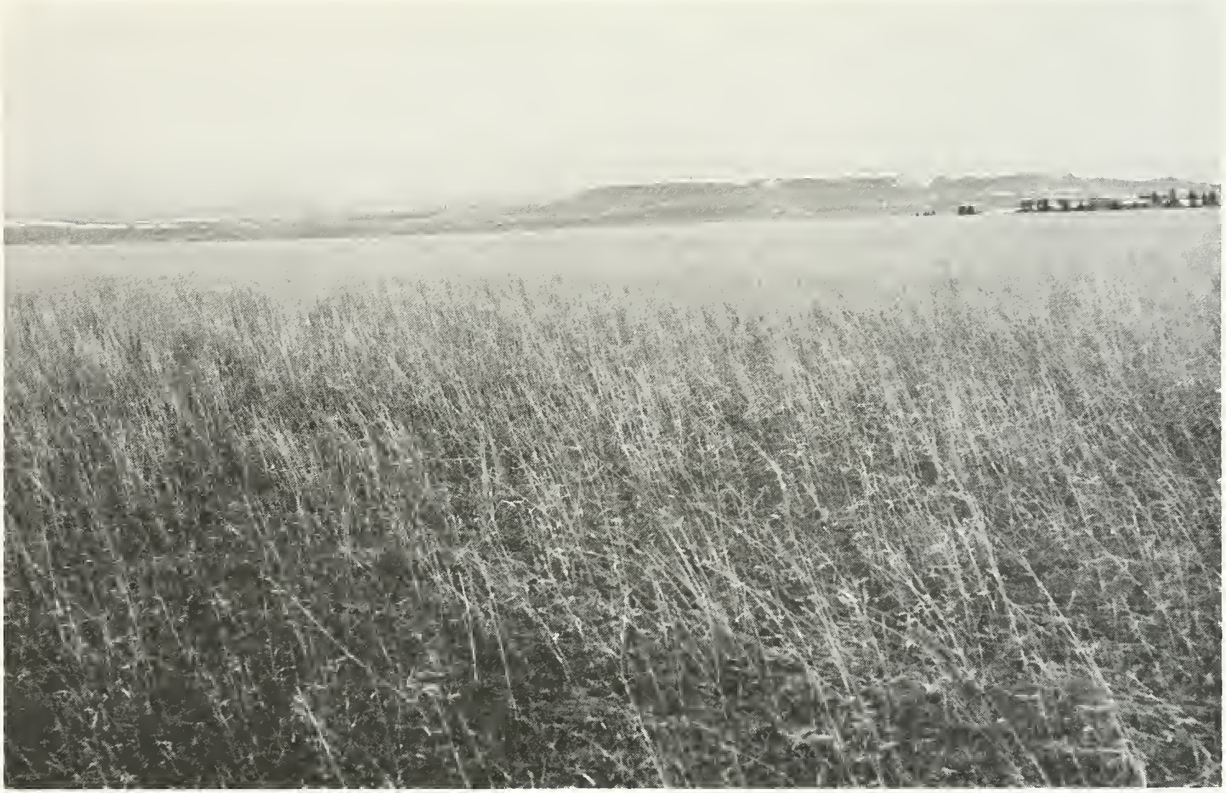


Figure III-6 Intensive agriculture on the Cottonwood Bench which has some of the most productive soils found in the study area. Transmission lines have little environmental impact when placed on nearly level slopes. However, the lines do create a nuisance in farming these lands.

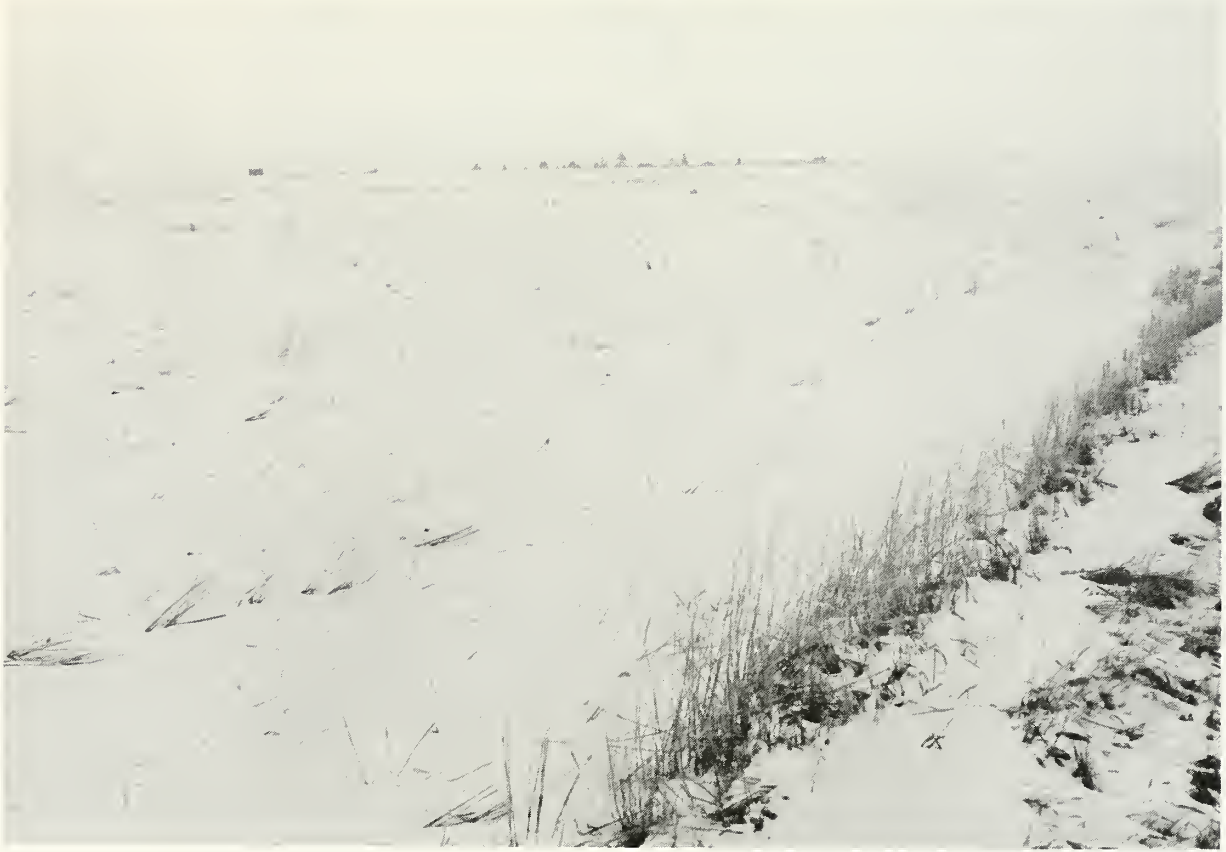


Figure III-7 Wheat stubble field exemplifying the intensive forms of agriculture on the Cottonwood Bench. The heavy snow accumulation is important in supplying moisture to crops and has played an important historical role in soil formation.

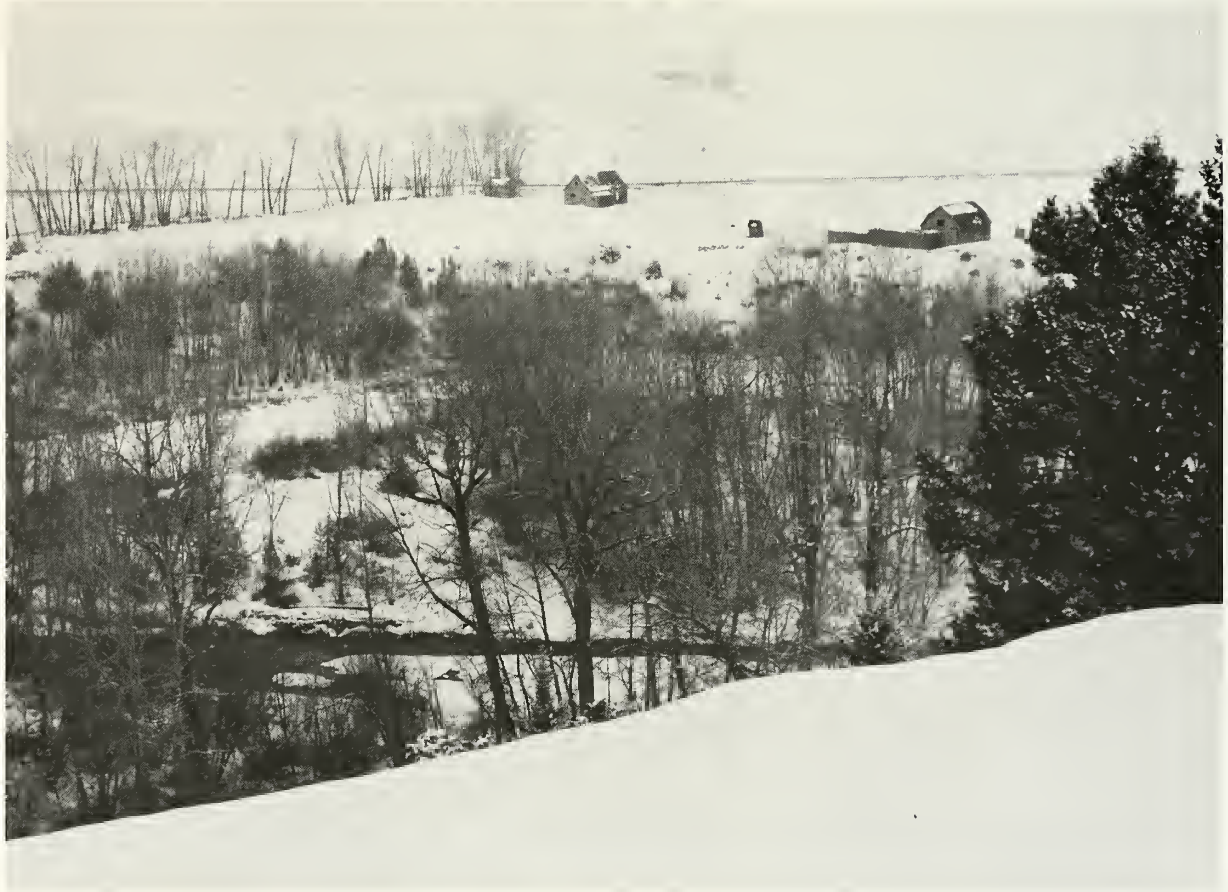


Figure III-8 Cottonwood Creek from the elevated outwash terrace. Riparian communities along the creek are important to maintenance of water quality in the watershed. Terraces in the distance are utilized for grazing and as irrigated hayland.

and important agricultural soils in that portion of the state. These soils frequently have dark colored surfaces and well developed subsoils or B horizons. Large amounts of gravel, stone and cobbles underlie most of these soils at varying depths and to some extent limit their water holding capacity and, ultimately, their productivity. Some of these terraces have such extensive gravel and stone concentrations in the surface horizons that they cannot be cultivated.

Two other major groups of soils include those found in the rolling uplands in the southwestern section of the study area and the soils found in the steep breaks and escarpments. The latter soils are generally shallow in depth over bedrock and are not as productive in terms of agriculture or timber as those soils with greater depths which are found on the flatter slopes. The rolling residual uplands are important to this area in terms of range forage production. Limited amounts of this broad group of soils are cultivated, primarily for dryland wheat. The bedrock which underlies many of these soils at depths ranging from 10 to 40 inches poses some limitations for their use and management. These soils generally have a dark colored surface horizon, a well developed subsoil or B horizon, and relatively fine clay loam and clay texture.

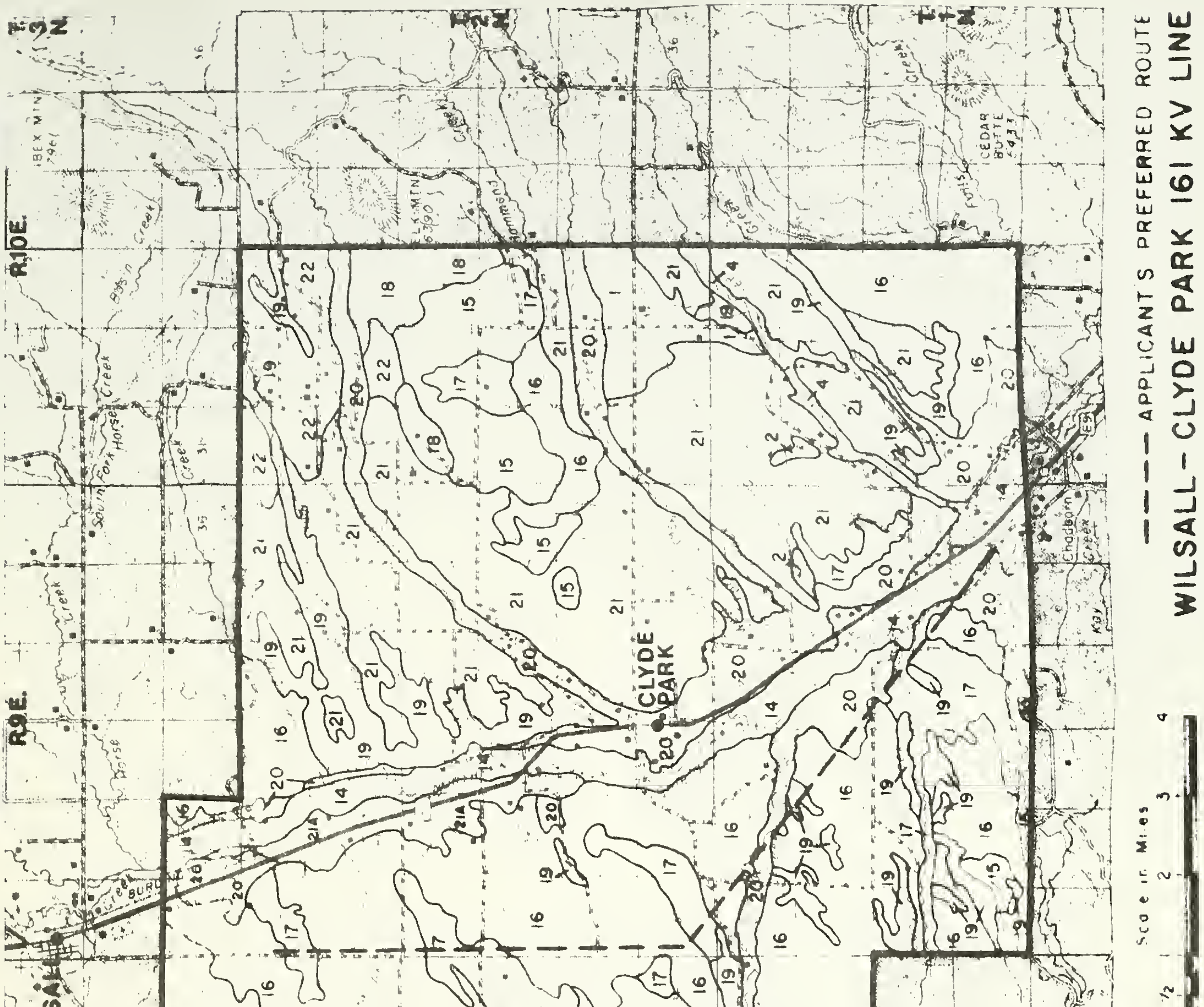
The basic taxonomic unit in soil classification is the soil series. A series is a group of soils that have broad similar properties and have developed from the same type of parent material. Several soil series may be combined to form soil associations when they occur on geomorphic features that have similar properties such as elevation, slope, parent material and effective precipitation.

The soil association is the most commonly used mapping unit for small scale maps.

The methodology utilized in the soil inventory for this study is as follows:

1) Collection of all existing Soil Conservation Service mapping in the study area.
2) Plotting of all locations where soil series had been identified during the initial review or progressive review.
3) Mapping of geomorphic surfaces through stereoscopic analysis of aerial photographs.
4) Correlation of the geomorphic surface with the soil series identified above.
5) Extension of the basic inventory data to areas for which there was no existing data.
6) Extensive field checking and analysis of mapping units for further establishment of "ground truth" data.
7) Transfer of final soil boundaries to the base map at a scale of 1:125,000 utilizing a Salzman projection unit.

The results of the soil inventory are shown in Figure III-9. The mapping units are defined in Table III-1. The level of mapping is that of the generalized soil survey. This is slightly broader in scale than a soil association map, dictated by the basic lack of existing data. However, the generalized soil map has sufficient detail and interpretative capability to effectively relate the sensitivity of the soil group to the placement of transmission lines.



GENERALIZED SOIL

LEGEND FOLLOWS IN TABLE III-1

— — — — APPLICANT'S PREFERRED ROUTE

WILSALL - CLYDE PARK 161 KV LINE

Figure III-9

TABLE III-1

EPC - Generalized Soil Mapping Unit Characteristics

Unit No.	Geomorphic Surface	Possible Included Soil Series	Subgroups	Families	Soil Depth	Characteristics	Slope Range
1	outwash terrace	Lithco	Typic Ustorthent	loamy skeletal, mixed (calcareous), frigid		inclusions of some soils with sandy skeletal control section.	0 to 5%
		Bitton	Entic Haploboroll	loamy skeletal, mixed			
		Datino	Typic Haploboroll	loamy skeletal, mixed			
		Hilger	Typic Argiboroll	loamy skeletal, mixed			
		Beaverton	Typic Argiboroll	loamy skeletal, mixed			
		GRAVELLY AND COBBLY PHASES					
2	wetland - alluvial floodplain	Larry	Typic Haplaquoll	fine loamy, mixed, frigid			0 to 2% (A)
		Somers	Aquic Haploboroll	fine silty over sandy or sandy skeletal, mixed			
		Canninger	Cumulic Haplaquolls	fine loamy, mixed (calcareous), frigid			
14	alluvial foodplains	Lohler	Typic Ustifluvent	fine, montmorillonitic (calcareous), frigid	>40"		0 to 2%
		Haverlon	Typic Ustifluvent	fine loamy, mixed (calcareous), frigid	>40		
		Korchea	Fluventic Haploboroll	fine loamy, mixed, frigid	>40		
		Straw	Cumulic Haploboroll	fine loamy, mixed, frigid	>40		

Unit No.	Geomorphic Surface	Possible Included Soil Series	Subgroups	Families	Soil Depth	Characteristics	Slope Range
15	moderately steep and steep residual uplands and strike ridges forming parts of the uplands	Cabba vs*	Typic Ustorthent	loamy, mixed (calcareous), frigid shallow	<10"	Castner is important inclusion in some areas -	15 to 60%
		Cabba			10-20"		
		Wayden vs*	Typic Ustorthent	clayey, montmorillonitic (calcareous), frigid shallow	<10"		
		Wayden			10-20"		
		Winifred	Typic Haploboroll	fine, montmorillonitic	20-40"		
		Roundup	Typic Haploboroll	fine loamy, mixed	20-40"		
		Regent	Tupic Argiboroll	fine, montmorillonitic	20-40"		
		Reeder	Typic Argiboroll	fine loamy, mixed	20-40"		
	*very shallow	Rock outcrop and very shallow phases of Cabba and Wayden range from 20 to 50 percent of the unit					
16	moderately steep residual lands frequently dominated by hog backs or strike ridges but including some rolling residual topography	Cabba	Typic Ustorthent	loamy, mixed (calcareous), frigid, shallow	20-20"	largely Class VI and VII, includes some Class IV - cultivated infrequently - inclusion of Farnuf and Savage - fine families dominant - cultivation confined to the Winifred, Roundup and Regent components	10-45%
		Wayden	Typic Ustorthent	clayey, montmorillonitic (calcareous), frigid, shallow	10-20"		
		Winifred	Typic Haploboroll	fine, montmorillonitic	20-40"		
		Roundup	Typic Haploboroll	fine loamy, mixed	20-40"		
		Reeder	Typic Argiboroll	fine loamy, mixed	20-40"		
		Regent	Tupic Argiboroll	fine, montomorillonitic	20-40"		
		Rock outcrop is less than 10 percent					
17	toe slopes and swails, largely within the uplands of the shale and sandstone regions	Regent	Typic Argiboroll	fine, montmorillonitic	20-40"	dominantly Class III and IV - generally cultivated - inclusion of Roundup, Cabba, and Wayden - fine families dominant	3 to 15%
		Savage	Typic Argiboroll	fine, montmorillonitic	>40"		
		Reeder	Typic Argiboroll	fine loamy, mixed	20-40"		
		Farnuf	Typic Argiboroll	fine loamy, mixed	>40"		
		Winifred	Typic Argiboroll	fine, montmorillonitic	20-40"		

Unit No.	Geomorphic Surface	Possible Included Soil Series	Subgroups	Families	Soil Depth	Allowable Range In Characteristics	Slope Range
18	hog back strike ridges and steep uplands	Kildor	Typic Cryoboroll	fine, mixed	20-40"	Kildor and Teton series have cambic horizons - some soils (underlain) with "lithic" type of bedrock	15 to 45%
		Owen Creek	Argic Cryoboroll	fine, montmorillonitic	20-40"		
		Teton	Typic Cryoboroll	fine loamy, mixed	20-40"		
		Doby	Typic Cryoboroll	clayey, montmorillonitic, shallow	20		
		Dra	Argic Cryoboroll	fine loamy, mixed	20-40"		
19	steep hog back strike ridges with steeply dipping beds and some residual excarpments	Cabba vs*	Typic Ustorthent	loamy, mixed (calcareous),	>20"	largely Class VII and VIII- inclusion of Regent, Reeder, and Castner - Winifred and Roundup an small proportion of the unit	30 to 60+%
		Cabba		frigid, shallow	10-20		
		Wayden vs*	Typic Ustorthent	clayey, montmorillonitic	<10"		
		Wayden		(calcareous), frigid, shallow	10-20"		
		Winifred	Typic Haploboroll	fine, montmorillonitic	20-40"		
		Roundup	Typic Haploboroll	fine loamy, mixed	20-40"		
	*very shallow	Rock outcrop ranges from 10 to 40 percent.					
20	low terraces alluvial fans and smaller alluvial floodplains	Tally	Typic Haploboroll	coarse loamy, mixed	>40"		0 to 7%
		Korchea	Fluventic Haploboroll	fine loamy, mixed, frigid	>40"		
		Shambo	Typic Haploboroll	fine loamy, mixed	>40"		
		Straw	Cumulic Haploboroll	fine loamy, mixed	>40"		
		Farnuf	Typic Argiboroll	fine loamy, mixed	>40"		
		Two Dot**	Typic Haploboroll	fine, mixed	>40"		

** description classifies Two Dot as fine loamy but the key to series classification indicates that it is fine.

Unit No.	Geomorphic Surface	Possible Included Soil Series	Subgroups	Families	Depth	Allowable Range In Characteristics	Slope Range
21	outwash terraces	Farnuf	Typic Argiboroll	fine loamy, mixed	>40"	all series frequently occur as gravelly phases - Farnuf, Savage and Lennep occur often as gravelly subsoil phases	2 to 10%
		Savage	Typic Argiboroll	fine, montmorillonitic	>40"		
		Len	Typic Argiboroll	clayey over loamy skeletal mixed	20-40		
		Lennep	Glossic Natriboroll	fine, montmorillonitic	>40"		
21A	alluvial fans	Farnuf	Typic Argiboroll	fine loamy, mixed	>40"	inclusion of Regent and Reeder in the upper portion of slopes - fine family seems dominant - some mottling or seep	2 to 15%
		Savage	Typic Argiboroll	fine, montmorillonitic	>40"		
		Lennep	Glossic Natriboroll	fine, montmorillonitic	>40"		
22	outwash terrace	Kildor	Typic Cryoboroll	fine, mixed	20-40	Kildor and Ora are underlain with loamy skeletal materials at depths of 20 to 40" - Series (1) and (2) have gravels at depths greater than 40" - gravelly phases are not uncommon -	2 to 10%
		Ora	Argic Cryoboroll	fine loamy, mixed	20-40"		
		(1)	Argic Cryoboroll	fine, mixed	>40"		
		(2)	Argic Cryoboroll	fine loamy, mixed	>40"		
		(3)	Argic Cryoboroll	fine, mixed	20-40		

3. IMPACTS

Impacts upon soil due to construction of the proposed line would not be great as long as mitigating measures are adopted and maintained. Without mitigating measures in force, the potential for secondary impacts increases. These potential impacts include:

1) Changes in land and soil use from urban to suburban development related to the increased availability of electricity in Clyde Park and the area traversed by the proposed line.

2) Increased potential for irrigation of new lands due to the increased availability of electricity.

3) Increased erosion during construction of the line due to disruption of the soil and vegetation systems.

4) Continued and accelerated soil erosion from maintenance activities associated with the line.

5) Loss of soil from production in areas associated with poles, maintenance facilities and substations.

C. VEGETATION

1. Inventory

Vegetation in the study area falls within the "Foothills Grassland Type" described by Payne (1973). The dominant physiographic features include mountains, rolling residual foothills, extensively dissected outwash terraces and alluvial floodplains. The principle forage species include the wheatgrasses (bluebunch wheatgrass and western wheatgrass), Idaho fescue, prairie junegrass, and needle-and-thread. Morris (1964) classified the area as a wheatgrass-fescue vegetation type. A large portion of the study area is dominated by grassland and sagebrush-grassland types.

The abundance of fescues has been considerably diminished during recent years, primarily due to overgrazing by domestic livestock. When livestock find a site that produces the type of plants they prefer, they tend to concentrate their grazing on such plants. This overuse of the more palatable species is the reason that season-long grazing by livestock tends to bring about changes in the species composition from a mixture of desirable species to an aggregation of inferior, low producing, undesirable plants (Wambolt 1974). Wright and Wright (1948) reported results of studies done on relict areas of south central Montana, including the Catholic cemetary one mile north of Bozeman and Rock Creek cemetary five miles east of Clyde Park, where the Idaho fescue type differed drastically from adjacent grazed areas. On each grazed site, Idaho fescue was absent or considerably diminished in relation to the relict areas where it was the dominant species. On each of the grazed areas, big sagebrush and prairie junegrass had increased in abundance.

A system to classify land units into habitat types was used in compiling the vegetation inventory. Studies conducted by W. F. Mueggler and W. P. Handl (1974) and R. D. Pfister, B. L. Kovalchek, S. F. Arno, and R. C. Presby (1974) were used to classify units of land capable of producing similiar communities at climax into the same unit or habitat type. Because the climax stage is the end result of plant succession, this system best reflects the integration of environmental factors affecting vegetation. Each habitat type represents a relatively small segment of environmental variation and thus describes a certain potential for vegetation development. It does not imply that there is an abundance of these climax species present because most areas are either in some stage of succession or have been disturbed by activities such as overgrazing. Environmental factors which are integrated into these classifications include climate, topography, soil type, and existing vegetation. Land areas smaller than 80 acres have not been included on the vegetation map (Figure III-10) and will not be mentioned unless special limiting or mitigating measures would be required in constructing the transmission line.

Figure III-10 shows the distribution of the five following habitat types within the study area:

a. Limber pine/bluebunch wheatgrass

This habitat type is often found on rocky breaks adjacent to grasslands in the foothills of the driest mountain ranges. Southerly to westerly aspects, steep slopes and calcareous soil deposits frequently characterize the type and produce a very arid condition. Rocky mountain juniper is represented as a major climax

associate and Douglas fir is sometimes found in the more moist, confined slopes. An assortment of xeric forbs and grasses found in the adjacent grasslands accompanies bluebunch wheatgrass in the understory. This assortment may include indian ricegrass, prarie junegrass, blue grama, prickly pear cactus, and phlox. Big sagebrush is also present in the existing vegetation but is thought to of limited importance at climax.

b. Douglas fir/bluebunch wheatgrass

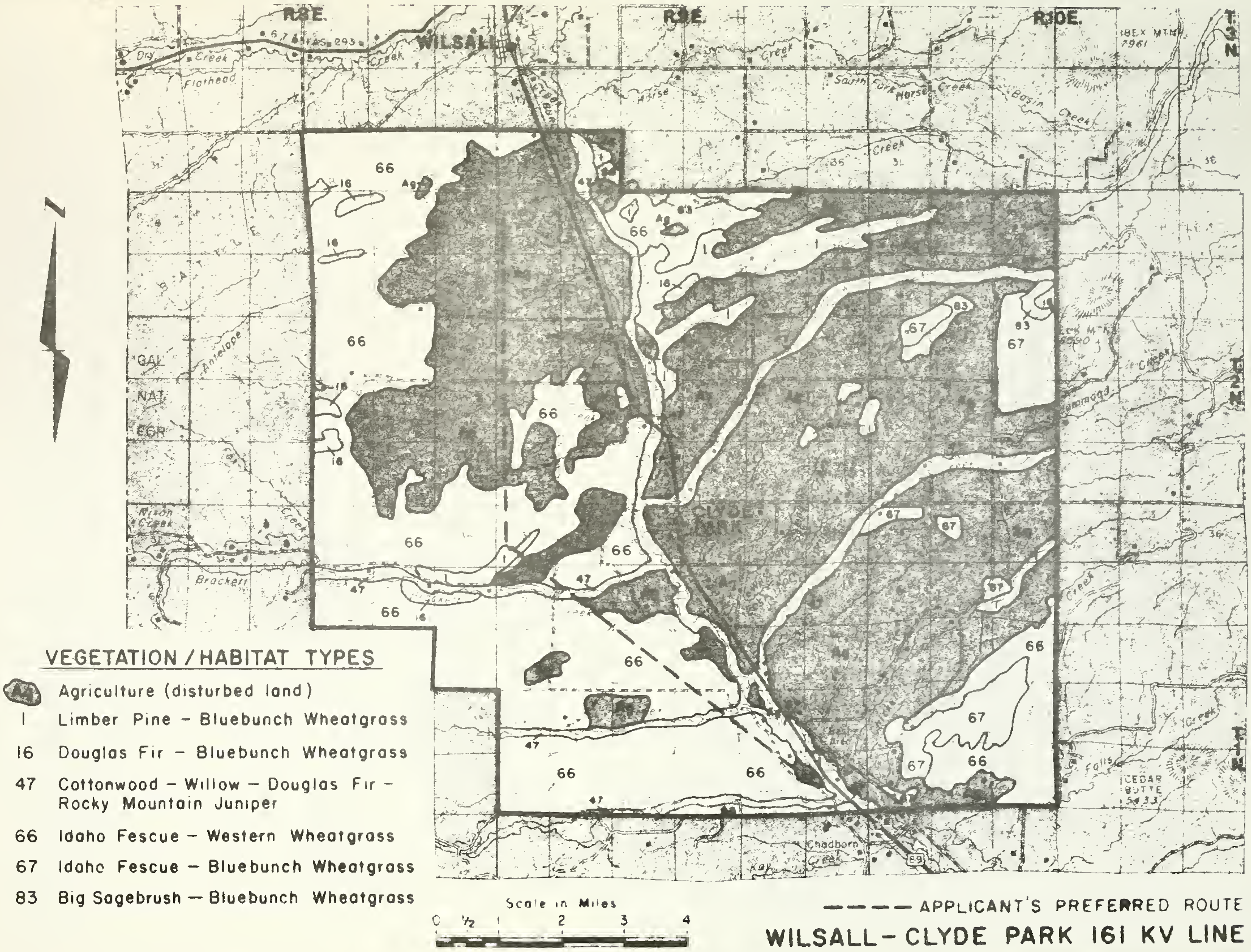
This habitat type is found in a few scattered locations and in the western foothills of Elk Mountain. There are widely scattered stands of limber pine and rocky mountain juniper associated with this unit. This habitat type is frequently found on steep areas having relatively shallow soils.

c. Idaho fescue/bluebunch wheatgrass

This habitat type is the most common mountain grassland in southwestern Montana. It occupies a wide elevational range from 2,600 to 9,000 feet and grows well on a variety of soils, preferring a well-drained sandy loam. Historically, the vegetation in these areas has been heavily grazed, and big sagebrush has become the dominant overstory species with bluebunch wheatgrass and prairie junegrass making up the understory.

d. Idaho fescue/western wheatgrass/thickspike wheatgrass

Rhizomatous wheatgrasses dominate the wheatgrasses in this habitat. The type is found in the heavier textured soils which lie on the western side of the study area. These sites have also



R8E.
R9E.
R10E.
T3N
T2N
T1N
WILSALL
CLYDE PARK
IBEX MTN 7961
CEDAR BUTTE 5433
Dry Creek
Flathead Creek
South Fork Horse Creek
Basin Creek
Antelope
Brackett
Nixon Creek
Chadborn
Kay Creek
GAL NAT FOR
89
66
67
83
16
47
1
Ag
VEGETATION / HABITAT TYPES
Ag Agriculture (disturbed land)
1 Limber Pine - Bluebunch Wheatgrass
16 Douglas Fir - Bluebunch Wheatgrass
47 Cottonwood - Willow - Douglas Fir - Rocky Mountain Juniper
66 Idaho Fescue - Western Wheatgrass
67 Idaho Fescue - Bluebunch Wheatgrass
83 Big Sagebrush - Bluebunch Wheatgrass
Scale in Miles
0 ½ 1 2 3 4
---- APPLICANT'S PREFERRED ROUTE
WILSALL - CLYDE PARK 161 KV LINE

Figure III-10

been grazed heavily and big sagebrush and prairie junegrass have invaded. Rabbitbrush, fringed sagewort, broom snakeweed, and other species also indicate that the area has been overgrazed.

e. Big sagebrush/bluebunch wheatgrass

This habitat type was utilized in generally very dry areas on slopes with a coarse textured soil. These are often steep slopes with shallow soils. Big sagebrush and bluebunch wheatgrass were the dominant species with prairie junegrass usually present.

There is a considerable amount of riparian (stream bank) vegetation within the study area. Areas surrounding the Shields River, Cottonwood Creek, and Bracket Creek are representative of this type and are dominated by narrowleaf cottonwood with a shrub understory of numerous species of willow, alder, quaking aspen, and rose. Mesic grasses and sedges such as smooth brome, basin wildrye, Canadian wildrye, timothy, and orchard grass are common to this type. Douglas fir is found mainly on the moist, steeper slopes along most of the riparian communities in the study area. Most of these areas are being used for the more intensive types of agriculture.

Land which is presently planted with introduced species, such as hay land, irrigated pastures, and cereal crops, is categorized in one section titled "agricultural land" in Figure III-10.

2. Impacts

a. Construction Phase

Construction of the proposed line will result in both short and long term impacts on vegetation. The length of time required

for recovery is directly related to the type of vegetation, soils, and topography encountered along the route and methods of construction employed.

As noted previously, the majority of the natural vegetation in the study area is either a grassland or grass-sagebrush type found on gently to moderately steep but rolling topography. Potential impacts resulting from construction of a transmission line over some portions of the area could be sizeable. Very little removal of vegetation is necessary except where access road construction is required and in the immediate area of structure locations. Vegetation removal results in an obvious disruption of the plant community and a vastly increased potential for sediment yield or soil erosion. Successful revegetation efforts can mitigate some of this impact over an extended time period.

Humus and litter material are broken down as a result of concentrated equipment use, and valuable nutrients needed to replenish the soil can easily be carried away by wind and runoff water. Soil compaction also occurs and ultimately causes some loss in plant production and increased potential for soil erosion. Areas of heavy sagebrush cover may possibly be improved in that subdominate plant species could be removed from competition with sagebrush. However, in many cases, the understory species are more palatable and productive than sagebrush and quick recovery of the sagebrush occurs because of selective grazing by livestock.

Areas of low growing vegetation such as grassland and grass-sagebrush offer few natural barriers to off-road travel. Construction of access roads therefore increases the impact on

additional areas. This situation is further compounded during times in which the soils are saturated or when the surface horizons are wet. This detrimental impact on vegetation causes rutting, accelerated erosion, loss in soil nutrients, losses of herbage production, and stream siltation.

River and/or creek bottoms will be paralleled or crossed by the proposed line. In these areas there is potential for impact on riparian vegetation which is critical for watershed protection. Loss of or damage to this habitat type will also result in damage to other elements of the environment such as fisheries, water quality, etc.. Excessive cutting of trees and brush along creek banks and driving equipment through streams causes a loss of bank stability, increased sediment load, and reduction in water quality. If creek banks are eroded excessively, flood potential could increase and vegetation could sustain further damage due to flood activity.

The vegetation along the excarpments and steep residual slopes is probably the most sensitive type within the study area. This is evidenced by the shallow soils, steep slopes, low productivity and sparse ground cover. Due to the slopes, these areas are also the most costly for transmission line location and would require more access roads in order to manuever materials and equipment to appropriate structure sites. Because of the inherent soil and vegetation instability of these areas, the construction of roads would result in greatly accelerated soil erosion, resulting in further reduction in vegetation production, loss of water quality, etc.

According to Packer (1967), observations and records show that most sediment from forest lands which reaches stream channels originates on logging roads. The study area is not forest land, but a system of access roads utilized for construction of transmission lines has similarities to a logging road system. In either case there is a need for proper design, location, construction and maintenance. Inherent features of the vegetation, soils, topography, and hydrology that indicate possible problem areas or areas which may be most amenable to location of roads must be taken into account. If existing roads can be utilized for transmission line access, the impacts of construction can be greatly minimized.

b. Operation & Maintenance

Impacts on vegetation resulting from operation of the proposed line, if any, should be relatively minor. Maintenance of the line should not cause excessive impacts on vegetation if equipment is restricted to permanent access roads whenever possible.

D. WILDLIFE

1. Inventory

The study area supports a diverse terrestrial fauna characteristic of the vegetation types described in the previous section. The Shields River is a major influence on animal distribution, and the greatest diversity of species is found either directly utilizing the river or inhabiting the dense riparian vegetation occurring on the floodplain. Animals typical of sagebrush-grassland and agricultural areas inhabit the benchland on either side of the river valley, and a few montane species are found in isolated stands of conifers along the steep canyons of upper Brackett Creek and Cottonwood Creek or wander into the valley from the nearby Bridger and Crazy Mountains. Large numbers of birds pass through this intermountain valley during spring and fall migration.

a. Mammals

Mammals known to occur in the study area are listed in Table III-3. Furbearers occupying the Shields River floodplain provide a source of income to local trappers, while hunting of deer and antelope within the study area and elk in the nearby mountains is a locally important fall recreational activity. There are no threatened or endangered mammals known to exist in the area.

The mule deer (_Odocoileus_ _hemionus_) is the most important big game mammal found in the study area. Mule deer range throughout the area, but are seldom found far from timber during summer and concentrate on winter ranges (see Figure III-11) usually characterized by sagebrush-grassland and juniper savanna. Over 120 wintering mule

TABLE III- 2 INVENTORY DATA FOR SELECTED MAMMALS KNOWN TO OCCUR IN THE WILSALL-CLYDE PARK STUDY AREA[1/]

SPECIES	HABITAT	MAJOR FOOD SOURCES	CLASSIFICATION, STATUS [2/]	HABITS [3/]	REMARKS
Mountain cottontail (Sylvilagus nuttallii)	Shrubbery, Forest edges, sagebrush	Vegetation, twigs, shoots	-	T	Abundant throughout the study area
Desert cottontail (Sylvilagus audobonii)	Sagebrush, plains grassland, junipers	Vegetation	-	T	This species reaches the eastern limits of its Montana distribution in the study area.
White-tailed jackrabbit (Lepus townsendi)	Sagebrush, grassland	Vegetation	-	T	Abundant, especially north of Clyde Park.
Yellow-bellied marmot (Marmota flaviventris)	Rocky areas	Grasses, forbs	-	FC	Common along the Shields River
Richardson's ground squirrel (Citellus richardsonii)	Grassland, sagebrush, pastures	Green vegetation	-	FC	Abundant throughout the study area.
Northern pocket gopher (Thomomys talpoides)	Various	Herbaceous plants, rootstocks	-	F	Locally abundant in pastures and grasslands
Beaver (Castor canadensis)	Along lakes, streams	Bark and small twigs, especially of cottonwoods, aspens, and willows	F	A	Have recently increased in abundance south of Clyde Park; dams are becoming troublesome in some areas.
Bushy-tailed woodrat (Neotoma cinerea)	Rimrock, cliffs, escarpments, abandoned bldgs.	Vegetation, twigs, shoots	-	T	Probably most abundant within the steep cliffs along Brackett Creek.
Voles (Microtus spp.)	Various	Vegetation, seeds, bark, insects	-	F	Four species, M. pennsylvanicus, M. montanus, M. ochrogaster, and M. longicavdus, are possibly sympatric in the study area.

Muskrat (Ondatra zibethicus)	Marshes, ponds, lakes, streams	Aquatic vegetation, aquatic organisms	F	A	Common in the Shields River
Porcupine (Erethizon dorsatum)	Coniferous forests, grassland, shrubbery	Buds, twigs, bark	-	T,R	Probably most common in woodlands along the Shields River and Cottonwood Creek.
Coyote (Canis latrans)	Various	Small mammals, birds	P	T	23 were observed by Dan Hook in and near the study area during a flight on January 29, 1975.
Red fox (Vulpes fulva)	Various	Small mammals, birds, insects, fruit	-	T	An important fur-bearing species
Raccoon (Procyon lotor)	Riparian woodlands	Various	-	TR	Common along the Shields River
Long-tailed weasel (Mustela frenata)	Various; usually near water	Mammals, birds	P	T	Probably most abundant along the Shields River
Mink (Mustela vison)	Along rivers, lakes, streams	Fish, small mammals, birds	F	TA	Probably most abundant along the Shields River
Badger (Taxidea taxus)	Open grassland, sagebrush	Small rodents, birds	-	F	Uncommon
Striped skunk (Mephitis mephitis)	Riparian woodlands, agricultural areas	Various	P	T	Common, especially along the Shields River
Bobcat (Lynx rufus)	Various	Small rodents, birds	P	T	An important fur-bearing species
Elk (Cervus canadensis)	Coniferous forests with open parks (summer); south-facing grassland slopes (winter)	Grasses, forbs, sagebrush	G	T	See Text
Mule deer (Odocoileus hemionus)	Coniferous forests, coulees, meadows (summer); sagebrush areas with tree cover (winter)	See Text	G	T	See Text

White-tailed deer (Odocoileus virginianus)	Riparian woodlands and adjacent fields	Snowberry, cottonwood, alfalfa, forbs	G	T	See Text
Pronghorn (Antilocapra americana)	Sagebrush, grassland	Sagebrush, grasses, forbs	G	T	See Text

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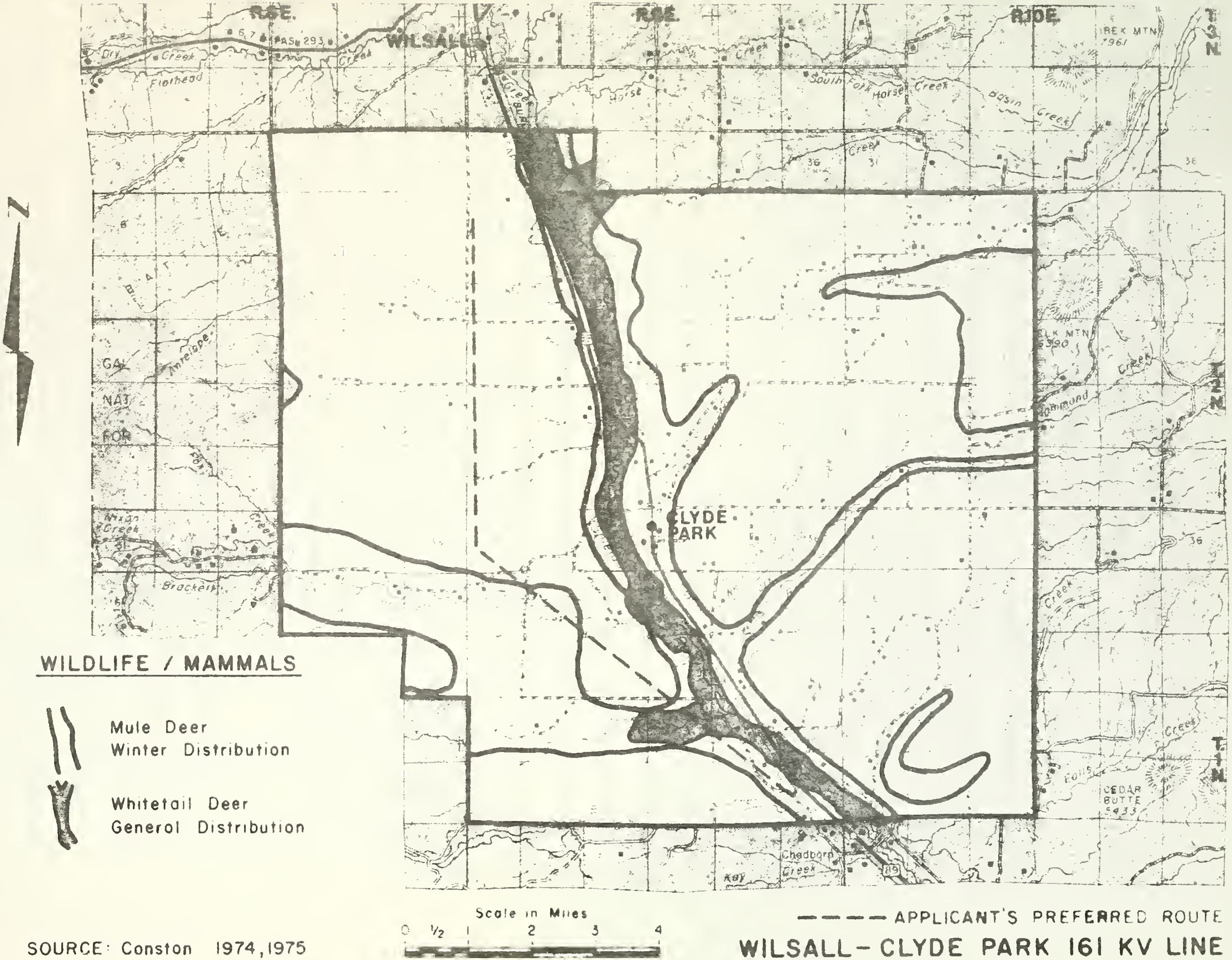
1/ Sources: Hoffmann et al. (1969), Hoffmann and Pattie (1968), Burt and Grossenheider (1959), Constan (1975), Hook (1975)

2/ F = Fur bearer; P = Predator; G = Game animal (as classified by the Montana Department of Fish and Game)

3/ F = Fossorial (burrowing); T = Terrestrial; R = arboreal; A = aquatic or semi-aquatic; C = colonial



---- APPLICANT'S PREFERRED ROUTE

WILSALL - CLYDE PARK 161 KV LINE

SOURCE: Conston 1974, 1975

Figure III-11

deer were observed on the Brackett Creek winter range on April 3, 1975. Winter range along the Shields River is shared with whitetail deer (Odocoileus virginianus).

Forbs, including alfalfa and arrowleaf balsamroot, are the most important summer food source of mule deer, while use of browse and grasses increases as forbs dry out in the fall. Browse, especially big sagebrush, is the most important food source on the winter range. However, browse on winter range in the study area is in generally poor condition due to overuse (Constan 1974). Use of forbs and grasses increases in the spring.

Elk (Cervus canadensis) are migratory in this area, summering in forest meadows high in the Crazy and Bridger Mountains and wintering in the foothills. Winter ranges and calving areas outlined by Constan (1974) lie just outside the eastern boundary of the study area, but wintering elk from the Crazy Mountain herd, which is estimated to be slightly under 100 in number, undoubtedly wander into the lower foothills of the study area, especially during severe winters. Calves are born in late May and early June, nearly always in areas where dense sagebrush surrounded by timber allows cows to hide their calves while feeding (Constan 1974; Reichelt 1973).

The study area lies entirely within elk and deer hunting districts (H.D.) 312 and 315, which are separated by U.S. 89. Numbers, classification, and productivity ratios for elk and mule deer observed in H.D. 315 and in that portion of H.D. 312 which lies within the Shields River drainage are given in Appendix E, Table 1. Hunter harvest estimates for H.D. 312 and 315 for 1973-74

are given in Tables 2 and 3 of Appendix E.

A herd of approximately 221 antelope (Antilacapra americana) winters just beyond the southeast corner of the study area. This herd usually remains in the same area all year and moves only a short distance from the winter range. However, antelope are known to inhabit the benchland south of Cottonwood Creek and a few individuals summer between Antelope Creek and Brackett Creek west of Clyde Park (Constan 1975). Sagebrush is a key forage source, especially during periods of heavy snow cover. Hunter harvest data for antelope hunting districts 338 and 339, which include the study area, are given in Table 4 of Appendix E.

b. Birds

Birds of the Livingston latilong (that area between 45° and 46° north latitude and 110° and 111° longitude), which includes the study area, have been listed by Skaar (1975). Most of these birds are probably found in the study area at various times of the year. More detailed information on waterfowl, large water birds, raptors, and upland game birds known to occur in or near the study area is listed in Table III-3.

There are no endangered bird species known to occur in the study area, although the peregrine falcon (Falco peregrinus) has been reported from nearby areas and may range into the Shields River drainage (Skaar 1969). The only threatened bird known from the area is the prairie falcon. Its presence is indicated by a single sight record (Hook 1975, see Table III-3). Status undetermined species, defined by the U.S. Bureau of Sport Fisheries and Wildlife (1973)

TABLE III-3

Waterfowl, Large Water Birds, Raptors, and Upland Game Birds Known to Occur In or Near the Wilsall-Clyde Park Study Area

SPECIES	HABITAT	DISTRIBUTION	CLASSIFICATION and STATUS1/	REMARKS
Western Grebe (Aechmophorus occidentalis)	Lakes, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration
Pied-billed Grebe (Podilymbus podiceps)	Ponds, lakes, reservoirs, streams	Cottonwood Res.	M	Uncommon in summer and fall; possibly breeds in the area.
White Pelican (Pelicanus erythrorhynchos)	Lakes, reservoirs	Cottonwood Res.	-	A flock of 18, probably arriving from Canyon Ferry reservoir, used Cottonwood Reservoir during the summer of 1974.
Great Blue Heron (Ardea herodias)	Shallow water, rivers, reservoirs	Along Shields River, reservoirs, stockponds	-	Rookeries are located along the Shields River north of Wilsall and south of Clyde Park (Fig. III-12)
Whistling Swan (Olor columbianus)	Lakes, reservoirs, large rivers	Cottonwood Res.	M	Uncommon in spring and fall during migration.
Canada Goose (Branta canadensis)	Rivers, lakes, reservoirs, grain-fields, islands	Cottonwood Res., Shields River	M	A few nest along Shields River between Wilsall and Clyde Park. 2 broods in Cottonwood Res. produced a total of 10 young in 1974.

Mallard (*Anas platyrhynchos*)	Lakes, ponds, rivers, reservoirs, grainfields	Cottonwood Res., Shields River	M	Common year-round; probably breeds in the study area.
Gadwall (*Anas strepera*)	Lakes, ponds, rivers, reservoirs, marshes	Cottonwood Res., Shields River	M	Uncommon in summer and during spring and fall migration.
Pintail (*Anas acuta*)	Lakes, ponds, rivers, reservoirs, marshes	Cottonwood Res., Shields River	M	Common during spring and fall migration.
Green-winged Teal (*Anas carolinensis*)	Lakes, ponds, rivers, reservoirs, marshes	Cottonwood Res., Shields River	M	Uncommon year-round
American Widgeon (*Anas americana*)	Lakes, ponds, rivers, reservoirs, marshes	Cottonwood Res., Shields River	M	Common in spring and fall during migration.
Northern Shoveler (*Anas clypeata*)	Marshes, ponds, reservoirs	Cottonwood Res., Shields River	M	Fairly common in spring and fall during migration.
Redhead (*Aythya americana*)	Marshes, lakes, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration.
Canvasback (*Aythya valisineria*)	Marshes, lakes, reservoirs	Cottonwood Res.	M	Fairly common in spring and fall during migration.
Lesser Scaup (*Aythya affinis*)	Marshes, ponds, lakes, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration.

Common Goldeneye (Bucephala clangula)	Lakes, rivers, reservoirs	Cottonwood Res.	M	Common in winter and during spring and fall migration.
Bufflehead (Bucephala albeola)	Lakes, ponds, rivers, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration
Ruddy Duck (Oxyura jamaicensis)	Marshes, ponds, lakes, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration.
Common Merganser (Mergus merganser)	Rivers, lakes, ponds, reservoirs	Cottonwood Res.	M	Uncommon in spring and fall during migration.
Goshawk (Accipiter gentilis)	Coniferous forests	Observed 10 miles east of Clyde Park, 7/10/74	-	Normally restricted to coniferous forests; occasionally wanders into valleys.
Red-tailed Hawk (Buteo jamaicensis)	Open country, woodlands	Widespread	-	The most abundant breeding raptor in the study area.
Swainson's Hawk (Buteo swainsoni)	Plains, foothills, rangeland, woodlands	Widespread	-	Rare in summer
Rough-legged Hawk (Buteo lagopus)	Open plains	A common wintering raptor, especially north of Clyde Park	-	Generally winters in the area from November to April.

Ferruginous Hawk (Buteo regalis)	Open plains	Observed 8/21/74 just northwest of the study area	-	Rare in summer
Golden Eagle (Aquila chrysaetos)	Open mountains, foothills, canyons, plains	Uncommon but wide-ranging	-	SEE Text
Bald Eagle (Haliaeetus leucocephalus)	Wintering eagles prefer riparian cottonwoods along major rivers, especially on islands	Along the Shields River	-	Winters along the Shields River, usually from November - April. 2 were observed near the Chadborne Substation on 4/2/75
Marsh Hawk (Circus cyaneus)	Marshes, fields, prairies	Most common just north of the study area	-	Fairly common year-round
Prairie Falcon (Falco mexicanus)	Open mountains, prairies, plains	Observed 5/8/74 in the northeast corner of the study area	T	The fact that this species is Seldom seen away from nesting sites after the middle of April indicates possible breeding in or near the study area.
American Kestrel (Falco sparverius)	Open country, prairies, woodlands, farmlands	Widespread	-	Common in summer and during spring and fall migrations.
Blue Grouse (Dendragapus obscurus)	Coniferous forests; in spring, surrounding foothills	Found in the nearby Bridger and Crazy Mts.; may range into the study area in spring	G	Males establish territories in the lower foothills in spring.

Ruffed Grouse (Bonasa umbellus)	Riparian shrubbery, cottonwood - willow bottons, coniferous forests	Uncommon along the Shields River and Brackett Creek	G	May have been fairly abundant in the mid-sixties, but has declined substantially; see Table 6, Appendix E, for harvest data.
Sharp-tailed Grouse (Pedioecetes phasianellus)	Prairie, thickets, forest edges	Found primarily in benchlands on either side of the Shields River	G	A dancing ground located on S7, T1N, R9E contained 17 males on 4/19/74 (Fig. III-). Numbers may be increasing (Table 6, Appendix E).
Sage Grouse (Centrocerous urophasianus)	Sagebrush plains	See Fig. for winter distribution and location of strutting grounds	G	SEE TEXT
Ring-necked Pheasant (Phasianus colchicus)	Shrubbery along river bottoms and streams, agricultural land	Found along Shields River and Cottonwood Creek; most abundant south of Clyde Park	G	An average of 1.5 calls/2 min. stop was recorded along the crow count route shown in Fig. III- Populations appear to be declining in the area. See Table 6, Appendix E, for regional harvest data.
Gray Partridge (Perdix perdix)	Grasslands, agricultural benchland, sagebrush	Throughout the study area	G	Numbers have apparently declined since the mid-sixties (Table 6, Appendix E).
American Coot (Fulica americana)	Ponds, lakes, marshes, reservoirs	Cottonwood Res., Shields River	-	Common in summer and during spring and fall migration.

Short-eared Owl (Asio flammeus)	Prairies	Observed 3 mi. W of Wilsall, 8/13/74	-	Uncommon

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1/ M = migratory waterfowl, G = upland game birds (as classified by the Montana Department of Fish and Game,) T = threatened species (as classified by the U.S. Bureau of Sport Fisheries and Wildlife, 1973).

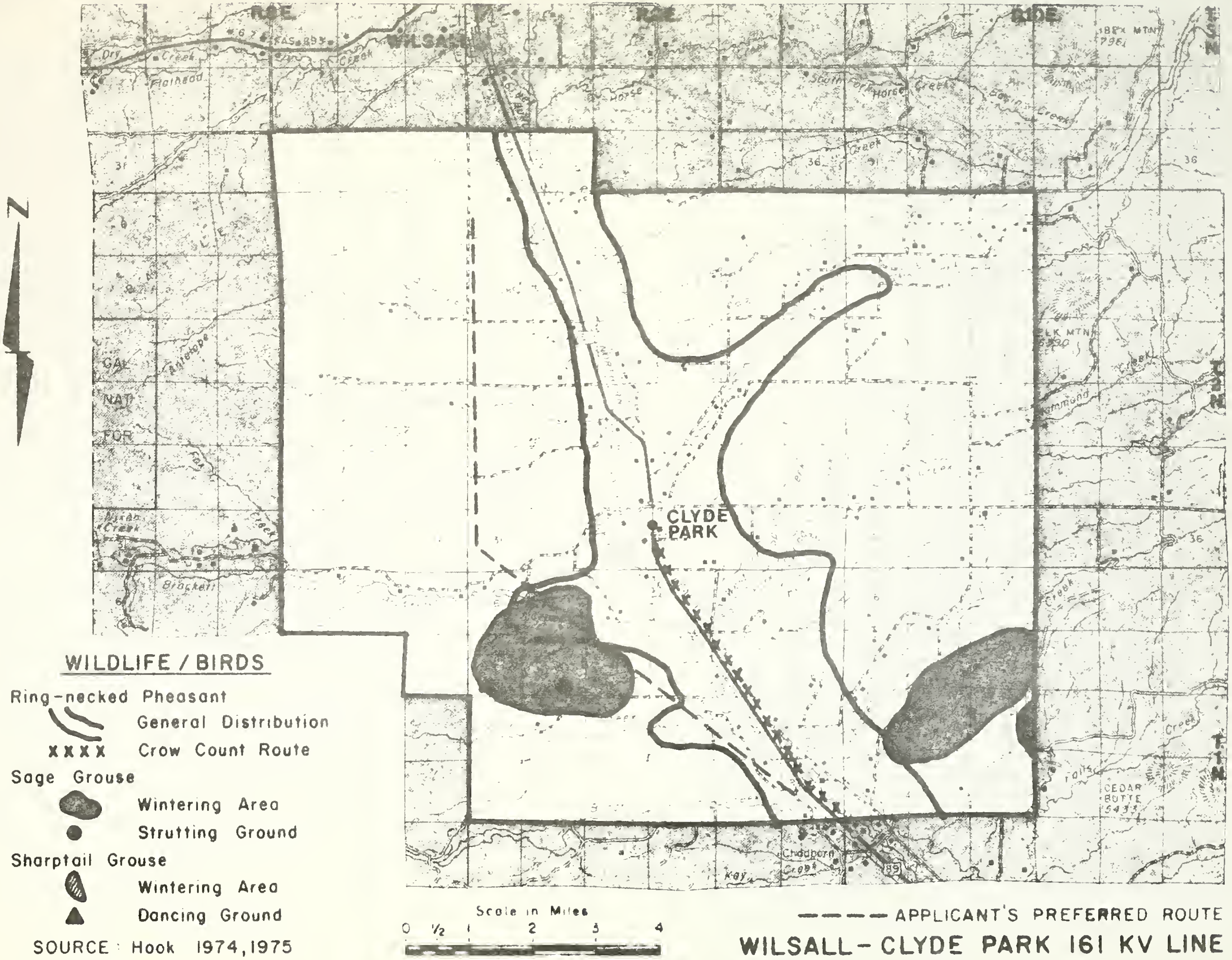
SOURCES: Hook (1974, 1975), Skaar (1969), Peterson (1969), Reynolds (1969), McGahan (1968), Mussehl (1960).

as those species which have been suggested as possibly threatened with extinction but about which there is insufficient information to determine status, include the ferruginous hawk (Buteo regalis) and northern long-billed curlew (Numenius americanus parvus).

The study area is situated on the eastern edge of the Pacific Flyway, and use by migratory waterfowl is not as intense as in other areas of the state. Waterfowl use the Shields River, irrigation reservoirs, and stockponds in the area as stopping-over sites during spring and fall migration. Several species may remain to breed during the summer, but breeding has been verified only for the Canada goose. Late summer and fall waterfowl use is restricted to the larger reservoirs which have not been dewatered (Hook 1974). Spring and fall waterfowl use of Cottonwood Reservoir, which lies north of Wilsall and is the largest reservoir in the vicinity of the study area, is presented in Appendix E, Table 5.

Reynolds (1969) and McGahan (1968) have studied golden eagle nesting activities and food habits in the area. The location of one nest has been reported, and it has been given consideration in corridor selection. The white-tailed jackrabbit, which is abundant in the study area, was found to be the most important year-round food source of golden eagles.

Harvest of upland game birds reported at the Wilsall check station (see Appendix E, Table 6) indicates that the sage grouse is the most important upland game bird in the study area. Sage grouse are highly dependent upon sagebrush as a food source, especially in winter (see Figure III-12). Their distribution in the study



WILSALL - CLYDE PARK 161 KV LINE

Figure III-12

area closely follows the remnant sagebrush areas west and southeast of Clyde Park. When mating takes place in the spring, males display on strutting grounds which are used year after year unless disturbed. Only one strutting ground (see Figure III-12) has been identified in the study area. The number of strutting males at this ground declined from 32 in 1973 to 26 in 1974. Females usually nest within a mile of the strutting grounds. Hatching peaks in the middle of June, with 77% of the hatch occurring between June 3 and June 24. Brood sizes range from 3-6 with an average of 4.7 (Hook 1974, 1975). The future of sage grouse in the study area is dependent upon the maintenance of suitable expanses of sagebrush. Further information for other upland game birds in the area is given in Table III-3.

2. Impacts of Proposed Action

Construction and operation of the proposed 161 KV transmission line may result in three types of impacts upon wildlife: displacement, increased mortality, and habitat alteration.

a. Displacement

Temporary displacement of large ungulates, non-burrowing small mammals, and birds is to be expected during and following construction activities. Deer and antelope will avoid areas of heavy machinery operation and human activity during construction, but will return to the right-of-way once construction is completed. There is no evidence that these mammals avoid operating transmission lines of the size proposed. Mule deer on the Brackett Creek winter range apparently do not avoid the existing Anaconda-Billings 161 KV line in spite of an audible hum. Breeding birds, notably raptors, may abandon nests if construction occurs nearby during the breeding season. Sage

and sharptail grouse may abandon historical display grounds if disturbed by construction activities in April and May.

3. Mortality

Increases in mortality rates of some species may result from the construction and operation of transmission lines. Burrowing mammals and nesting passerine birds would be destroyed in the immediate vicinity of pole drilling sites, staging sites, and access roads. These species characteristically have high reproductive rates, and population levels are likely to return to normal in a relatively short time. However, the impact of mortality may be significant if large colonies of colonial species, such as bank swallows or prairie dogs, are destroyed as a result of construction.

Electrocution of raptors perching on power lines has been reported by Boeker Hannum et. al. (1974), and the U.S. Department of Agriculture (1972). Raptors commonly perch on utility poles, especially in open sagebrush or grassland areas lacking natural perches. Certain poles, which offer an especially wide view of a wide hunting area, are preferred and are used much more frequently than adjacent poles. Electrocution results when the wings of the bird contact a conductor and a ground wire simultaneously. Young and inexperienced birds, which commonly approach the poles with wings spread, are the most common victims of electrocution. However, it should be noted that nearly all electrocutions are associated with power distribution lines. The distance between conductors and between conductors and ground wires is sufficiently great on double-pole 161 KV transmission lines that raptor electrocutions are highly unlikely (Hannum et. al. 1974; Crawford and Dunkeson 1973.)

The tendency of large raptors to use utility poles as perches in open areas makes these birds vulnerable to illegal shooting, expecially in areas where the right-of-way closely parallels paved or gravel roads. The scarcity and low reproductive potential of large raptors, notably bald and golden eagles, renders populations of these species especially sensitive to small increases in mortality.

Collisions with utility wires have been known to cause mortality of waterfowl (Cornwell and Hochbaum 1971; Stout 1967; Willard and Willard 1972) and a wide variety of other birds, including sage grouse (Borell 1939) and sandhill cranes (Walkinshaw 1956). Wire strikes by waterfowl are most frequent during spring and fall migrations (Stout 1967) and are often associated with snowstorms and periods of heavy fog (Willard and Willard 1972; Banko 1960). Puddle ducks are apparently more vulnerable to wire strikes than are other waterfowl species (Stout 1967). The incidence of wire strikes may increase if the proposed facility is sited near the Shields River where large numbers of migrating waterfowl concentrate. However, this would represent a very small percentage of the total non-hunting mortality of these birds.

3. Habitat Alteration

Habitat alteration caused by the construction and operation of the proposed facility is expected to be insignificant. Temporary or permanent access roads would result in greater habitat destruction than roadless construction methods and could adversely

affect mule deer winter range by reducing the amount of available forage. Clearing of riparian shrubbery or conifers along the right-of-way may temporarily reduce cover and forage availability, but this impact can be kept to a minimum by carefully monitoring construction.

E. AQUATIC FAUNA

1. Inventory

a. Fisheries

The following information pertaining to the distribution and abundance of fish species in the study area was obtained from inventory data collected by the Montana State Department of Fish and Game. That department is conducting a continuing study of the Upper Yellowstone River drainage in order to determine the physical, chemical, and biological characteristics of waters of importance or potential importance to the area's recreational fishery (Peterman 1974).

The Shields River and permanent tributary streams within the study area contain a variety of sport fish species, including rainbow trout (*Salmo gairdneri*), brown trout (*Salmo trutta*), Yellowstone cutthroat trout (*Salmo clarki*), brook trout (*Salvelinus fontinalis*), and mountain whitefish (*Prosopium williamsoni*). Rainbow-cutthroat trout hybrids are also present in the river and its tributaries. Non-sport fish species include longnose sucker (*Catostomus catostomus*), mountain sucker (*Catostomus platyrhynchus*), white sucker (*Catostomus commersoni*), longnose dace (*Rhinichthys cataractae*), and mottled sculpin (*Cottus bairdi*). One record of a lake chub (*Couesius plumbeus*), was reported from Antelope Creek during the 1974 electrofishing stream survey (see Appendix F, Table 1).

Brown trout and mountain whitefish provide the major fisheries of the Shields River within the study area. Mountain whitefish provide an excellent winter fishery, although, despite liberal regulations and large populations, the species remains lightly harvested (Workman 1975). Populations of brook trout and Yellowstone cutthroat trout are present in most of the tributary streams having a permanent flow and provide

recreation for local fisherman (Ellig 1975; Workman 1975). Mottled sculpin and longnose dace are an important food source for the trout populations of the study area (Peterman 1974).

The Shields River has many problems not uncommon to other tributaries throughout the Upper Yellowstone River drainage. Johnson (1964) inventoried the Shields River to determine the extent and frequency of man-made channel alterations and found that over 20% of the stream had been altered. Agricultural activities accounted for approximately 90% of the alterations. Wipperman and Elser (1968) reported that about 15% of a section along the Shields River north of Wilsall was in an altered condition. Channel alterations and eroding banks are common along the entire river (Workman 1975).

Dewatering of the Shields River is a problem that is increasing each year in the study area. During the summer months, tributary streams are seriously dewatered along their lower reaches, and as demands for irrigation water become greater, less and less water is available to provide favorable habitat and spawning conditions for fish (Workman 1975; Berg 1975; Elser and Marcoux 1971).

The accumulation of sediment is a serious problem that is reducing the potential of area fisheries. Overgrazing by livestock with the resultant removal of protective riparian vegetation along the Shields River and its tributaries, has increased erosion potential. The movement of livestock along stream bank areas is also accelerating sedimentation. Evaluation of recent fisheries data collected by the Department of Fish and Game is expected to

show that land use activities in the headwater areas of the Shields River drainage are adding substantial amounts of silt and sediment to the already high silt loads carried by the river during the early spring. This may be further adding to the reduction of the fisheries potential of the river (Workman 1975; Berg 1975).

Tributary streams within the study area exhibit a lower gradient than most of the other tributaries of the Upper Yellowstone River drainage, and as a result, they are particularily vulnerable to sediment deposition. A low stream gradient retards the ability of the stream to remove or flush accumulated silt and sediment from its channel. Under normal conditions the streams probably were able to facilitate the removal of accumulated silt fairly well, without substantial effect upon biotic communities. However, the additional silt and sediment from agricultural sources has decreased the efficiency of this removal, thus altering the potential productivity of these streams (Workman 1975).

A portion of the Shields River located approximately two miles north of Wilsall (Section 5, T3N, R9E) was sampled in 1967 to determine the relative abundance and species composition of the trout population. Population estimates were calculated for brown and cutthroat trout. Rainbow and brook trout were present, but estimates were not calculated because of small sample sizes. Mountain whitefish appeared to be the most abundant salmonid, but the species was not included in the estimates (Wipperman and Elser 1968). Brown trout were the predominant trout species, comprising 89.5% of the total number, while Yellowstone cutthroat trout

contributed 10.1%. Rainbow and brook trout made up the remaining 0.4% (based on total number observed). Further data concerning fish size and age are presented in Tables 2 and 3 of Appendix F.

The age structure of most stream-dwelling trout populations is stable, since older age groups are represented by successively smaller numbers of fish. An older age class seldom constitutes the bulk of the population. However, McFadden and Cooper (1962) suggested that deviation from this scheme encountered in three Pennsylvania streams was coincident with adverse environmental conditions.

In 1970, eyed Yellowstone cutthroat trout eggs were utilized by the Department of Fish and Game to evaluate the effects of sedimentation on the salmonid population of the Shields River. The eyed eggs were placed in artificial redds. Six stations were established for the Yellowstone River to approximately two miles upstream from Wilsall. Turbidity was measured at approximately 10-day intervals. Following the period of time necessary for the eggs to complete hatching, as determined from the water temperatures, the artificial redds were dug up, and the number of eggs remaining were counted and mortality rates determined (see Appendix E, Table 4). Greatest mortality occurred at the station with the highest turbidity reading, while the lowest mortality occurred at the location with the least turbidity. However, between those two stations, no correlation was evident. This could have been the result of poor techniques in redd construction. The results suggest that the amount of turbidity could be related to hatching success in the Shields River (Elser and Marcoux 1972).

Appendix F presents results of electrofishing surveys conducted by the Department of Fish and Game on three sections of the Shields River within the study area in 1974 (Table 1) and an 11,600-foot section of the river near Clyde Park in 1972 (Table 4). These survey results are currently being evaluated by the Department of Fish and Game. However, since the stream characteristics that resulted in the trout population dynamics in 1967 (see Appendix F, Tables 2 and 3) have not improved, the present data is expected to reveal a similar population trend (Berg 1975).

Results of the 1974 electrofishing survey of the tributaries to the Shields River within the study area are presented in Appendix F, Table 1. Several tributaries not included in the table are either ephemeral in nature or are reduced through irrigation water demands to such an extent that they are not capable of supporting fish populations (Workman 1975).

b. Aquatic invertebrates

As part of the Upper Yellowstone River Drainage Planning Inventory Program, the Department of Fish and Game established aquatic invertebrate sampling stations along the Shields River in 1974. Information obtained in 1974 is presently being evaluated (Newell 1975).

2. Impacts

The major impacts which the construction and operation of a 161 KV transmission line would have upon aquatic ecosystems in the study area are those associated with the addition of silt and sediment to streams.

Construction on steep grades, lack of allowance for proper drainage, excessive removal of riparian vegetation, and close proximity of roads to stream channels are factors particularily conducive to siltation.

Silt and sediment can affect the living organisms in any stream, either through the physical and chemical changes which the silt produces in the waters or through alterations in substrate conditions resulting from the settling of all or part of the silt load (Ellis 1936).

Alteration of substrate condition is the impact most likely to occur in the waters of the Shields River and its tributaries. As discussed in the inventory section, the tributaries of the area are especially vulnerable to the accumulation of silt with the resultant substrate alteration because of the low gradient they exhibit. Silt accumulation can reduce favorable habitat for sport fish species and their food organisms by filling pool areas in the stream. Saunders and Smith (1964) reported that low standing crops of brook trout in Ellerslie Brook, Prince Edward Island, were closely associated with silting, and appeared to result from the destruction of pool areas in the stream in which the fish hid. With a reduction of favorable habitat, trout or other sport fish disappear and less desirable species replace them in the stream community complex (Peters 1962). The addition of gross quantities of sediment not only changes the community of aquatic organisms within a stream but also diminishes the total productivity of the stream (Cordone and Kelley 1961).

The adverse effects of silt upon the spawning success of sport fish is a well documented fact (Elser and Marcoux 1971; Saunders and Smith 1965; Peters 1962; Cordone and Kelly 1961). Clean permeable gravels provide the nursery areas for trout embryos in the stream environment. Suspended sediment in the water during the incubation period can greatly affect the survival rate of developing trout embryos by clogging the pore spaces between the gravels. Consequently, the seepage rate and supply of oxygen necessary for successful embryo survival diminishes, resulting in high embryo mortality (Peters 1962). Poor young-of-the-year recruitment of brown trout appears to be an existing problem in the Shields River (see Appendix F, Table 2) (Berg 1975).

Substantial quantities of inorganic sediment entering a flowing stream can seriously reduce the abundance of benthic invertebrates and reduce the species diversity of the community (Cordone and Kelly 1961; Bachman 1958; Tebo 1955; Wustenberg 1954). Trout food habit studies in stream situations have consistently shown the dependence of trout on aquatic invertebrates, particularily insects. At times, terrestrial organisms play a significant role in the sport fish diet, but under normal conditions the bulk of sport fish diets consists of aquatic forms. Tebo (1955) states that within limits of space and reproductive capacity, the available food in a stream can certainly be regarded as a factor limiting the production of sport fish. Leonard (1948) and Henry (1949) have stated that in Michigan trout waters, the food supply often is the most important factor limiting trout production. Allen (1951), working on New Zealand streams, found that the amount of bottom fauna was a limiting factor in the production of brown trout.

The existing condition of the aquatic invertebrate populations of the waters within the study area is currently being evaluated (Newell 1975). Therefore, the extent of silt and sediment impact upon the aquatic invertebrate populations from sources associated with the construction and maintenance of the proposed transmission line is unknown. However, any condition that might deteriorate the existing stream environment should be avoided.

The importance of maintaining proper land use values along the waters in the study area is becoming increasingly evident, as existing sedimentation and water use problems continue to reduce the amount of suitable habitat available to the sport fish species (Workman 1975). If the sport fisheries of the study area are to be improved, an effort must be made to correct existing problems and carefully evaluate potential sources of future problems.

IV. Cultural Characteristics and Impacts

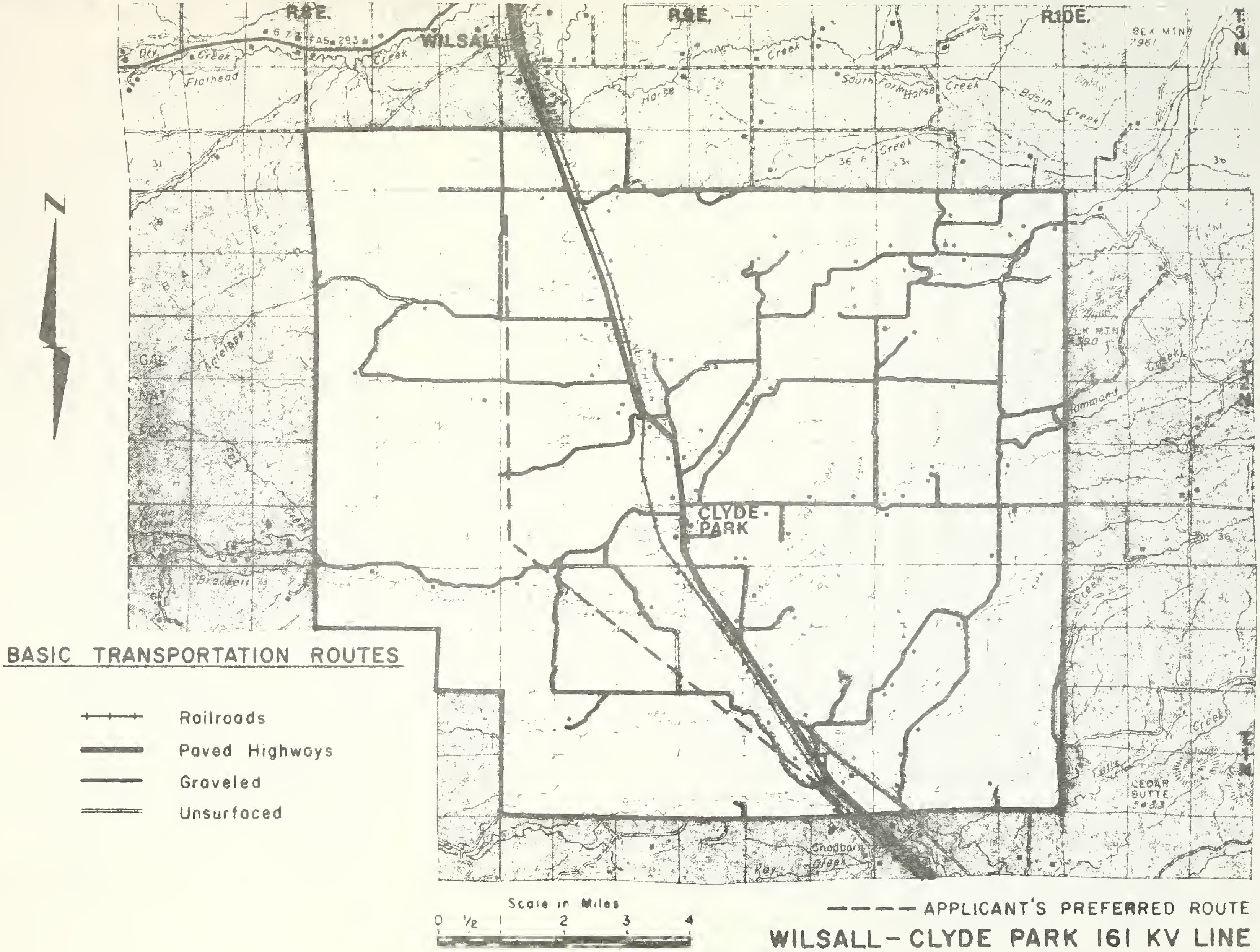
A. LAND USE

1. Inventory

Land use in the study area is characterized by a predominance of grazing and dry crop land with irrigated crop land primarily located in or adjacent to the floodplains. Nonfarm residential property is principally located around Clyde Park which is located in the approximate center of the study area, situated on the east side of the Shields River on Highway 89. Ranch houses and related structures are scattered along the Shields River and its tributaries.

Highway 89 crosses the study area in a general north-south direction, approximately paralleling the Shields River. A spur of the Burlington-Northern Railroad linking Livingston with White Sulphur Springs also traverses the study area, paralleling the highway and river. Numerous gravel roads extend primarily in an east-west direction from Highway 89. These roads provide local access to ranches and recreational areas in the foothills and uplands of the Crazy and Bridger mountain ranges (see Figure IV-1).

A 69 KV transmission line operated by the local REA extends from the Clyde Park substation north to Wilsall. This facility is a single pole structure located west of Highway 89 at distances ranging from 1/4 mile to two miles from the road. Three major MPC transmission lines are also located in the study area. The Anaconda-Billings 230 KV line crosses the northern



BASIC TRANSPORTATION ROUTES

WILSALL - CLYDE PARK 161 KV LINE

Figure IV-1

portion of the area following an east-west path. This facility would act as the northern terminus for the proposed Wilsall-Clyde Park transmission line. The Anaconda-Billings 161 KV line also crosses the study area from east to west, tying into the Clyde Park substation, the southern terminal of the proposed facility. The Bozeman 161 KV "A" line originates at the Clyde Park substation and proceeds in a southwesterly direction to Bozeman. A right-of-way for telephone and electric distribution lines follows Highway 89.

Clyde Park, with a 1970 population of 244, is the only municipality within the study area. The town functions as a local service center for the surrounding agricultural population. There are no industrial sites, mining or lumbering operations within the study area. The area's economic base is agriculture and area land use patterns reflect this focus.

The study area contains one known archaeologic site referred to as Madsen's Rings. The site is classified as a habitation site and is located east of Clyde Park in T2N, R9E.

2. Impacts

The major land use impact which would be created by the proposed facility is the removal of a small amount of agricultural land from cultivation. The proposed substation at the northern terminal of the line would convert approximately two acres of agricultural land to utility usage, providing the entire site is used for the substation. Existing 230 KV and 161 KV lines in the study area are apparently not major impediments to agricultural land use. Pole placement and accompanying road access may interfere

with cropping systems to the degree that operation or movement of farming equipment is altered. Since there is a limited amount of sprinkler irrigation in the study area, anticipated impacts or interference with these facilities can be largely avoided.

B. VISUAL PATTERN

1. Inventory

The study area consists of rolling hills and pediments dissected by streams flowing to the Shields River. Vegetative cover consists of native grasses and shrubs, agricultural crops, and stands of deciduous trees along the creek bottoms. There are no large stands of conifers. The visual character is that of an open prairie vista at the foot of the mountains. The study area is actually in the center of a broad valley with mountain panoramas visible on three sides. Highway 89, the main transportation artery in the study area, is also the principal point from which most people would view the proposed facility. Transmission lines removed from the immediate view of the highway would be seen almost entirely by local residents and recreationists seeking off-highway diversions.

2. Impacts

If the visual presence of a transmission line upon a landscape is viewed as a negative impact, then there are no locations within the study area that will not be impacted. Therefore, the problem is to minimize negative visual effect. At least three alternatives are possible:

1) The proposed facility can be erected on or adjacent to the right-of-way of an existing transmission facility. This point of view premises that the visual damage is already an accomplished fact. Thus, an additional line will not significantly impact visual resources.

2) The line can be screened from the view of most potential observers. The only way to completely screen a transmission line is to place it underground. In the study area, some screening can be accomplished by placing the line a considerable distance from the most prominent view points. In this way the line shrinks in size as the viewers visual perspective is enlarged. Another method of screening is to arrange the line so that objects such as hills, stands of trees, etc. prevent observation of the facility.

3) The line can be constructed in areas where it would have a strong visual association with other man-made linear elements such as railroads, other power lines, or highways. In this case visual impact is reduced because the line is an expected part of the landscape.

The applicant's preferred route is an example of minimized visual impact by 1) association with another transmission line and 2) screening the object from view by distance (from the highway) and topography (small hills intercept the view from the highway). Use of vegetative cover to screen a transmission line is impossible except in the creek bottoms where there are stands of trees, and non-visual impacts of a route through such areas preclude this choice.

C. SOCIAL CONDITIONS AND DEMOGRAPHY

1. Inventory

The Shields River valley was settled in the early 1870's by stockmen and has always been an agricultural area. Ranches are relatively large and the population is low. In 1970, the Shields Valley Census Subdivision, which includes all of Park County north of the Yellowstone River, registered a population of 1,808 persons. This figure represented an increase of 109 persons from 1960. The Shields Valley was the only census subdivision in Park County that showed population growth during the last decade. Park County lost a total of 1,971 persons during the period of 1960-1970. This pattern of population decline was also repeated in neighboring Meagher, Wheatland, and Sweet Grass counties. In Gallatin County, however, 6,000 additional residents brought the 1970 population to 32,505.

2. Impacts

Social impacts of a transmission line in this situation are essentially of two types -- local and dispersed. The first case, local impacts, primarily involves nuisance effects accompanying

line construction and operation. For example, workers may leave gates open, allowing cattle to wander; construction and maintenance vehicles may cause damage to crops and fences; radio and television interference may result from line corona; etc.[1] In some instances these impacts can be avoided or mitigated by careful route selection and construction techniques.

A second type of impact, the dispersed impact, is a product of the transmission facility's relationship with its users. This case involves the effect of the line on the distribution and reliability of electrical service. The applicant has indicated that the proposed facility is needed to more reliably serve the growing electrical demand of a multi-county area in south and southwestern Montana. Thus the impact of the proposed facility cannot be solely evaluated on the basis of site specific criteria. Population growth (e.g. Gallatin County) which, in some fashion, translates into load growth, is occurring in areas served from the Clyde Park substation. Assessment of the impact of the proposed facility on electrical consumers is difficult and beyond the scope of this report. Therefore, the impact of the facility from this perspective remains unspecified.

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[1] For a more detailed discussion of these impacts, see Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 & 4, 500 Kilovolt Transmission Lines and Associated Facilities, Volume 4, Section 6.2.3.2. (DNRC, 1974)

D. ECONOMIC CONDITIONS

1. Inventory

The northern portion of Park County is agricultural in its economic focus. Services, principally commercial and governmental in nature, constitute a small portion of the area's economic base. Industry is non-existent. Earnings and income vary with the condition of agricultural markets, but, on the whole, the area has a stable economic base.

2. Impact

The proposed facility would create little local impact. The construction crew would be small and probably imported. Additional incomes generated in this manner would be negligible. The major contribution to the area would be the taxable valuation of the line, estimated at approximately $54,720. At the current 1974-75 county mill levy, the line would generate approximately $5,500 in tax revenue. However, the actual fiscal impact of the line is contingent upon its valuation as determined by the Montana Department of Revenue. Therefore, the preceeding figures may not be absolutely reliable.

The dispersed impact of the facility, as in the preceeding section dealing with social impacts, has not been estimated.

Section V Recommendations and Mitigative Measures

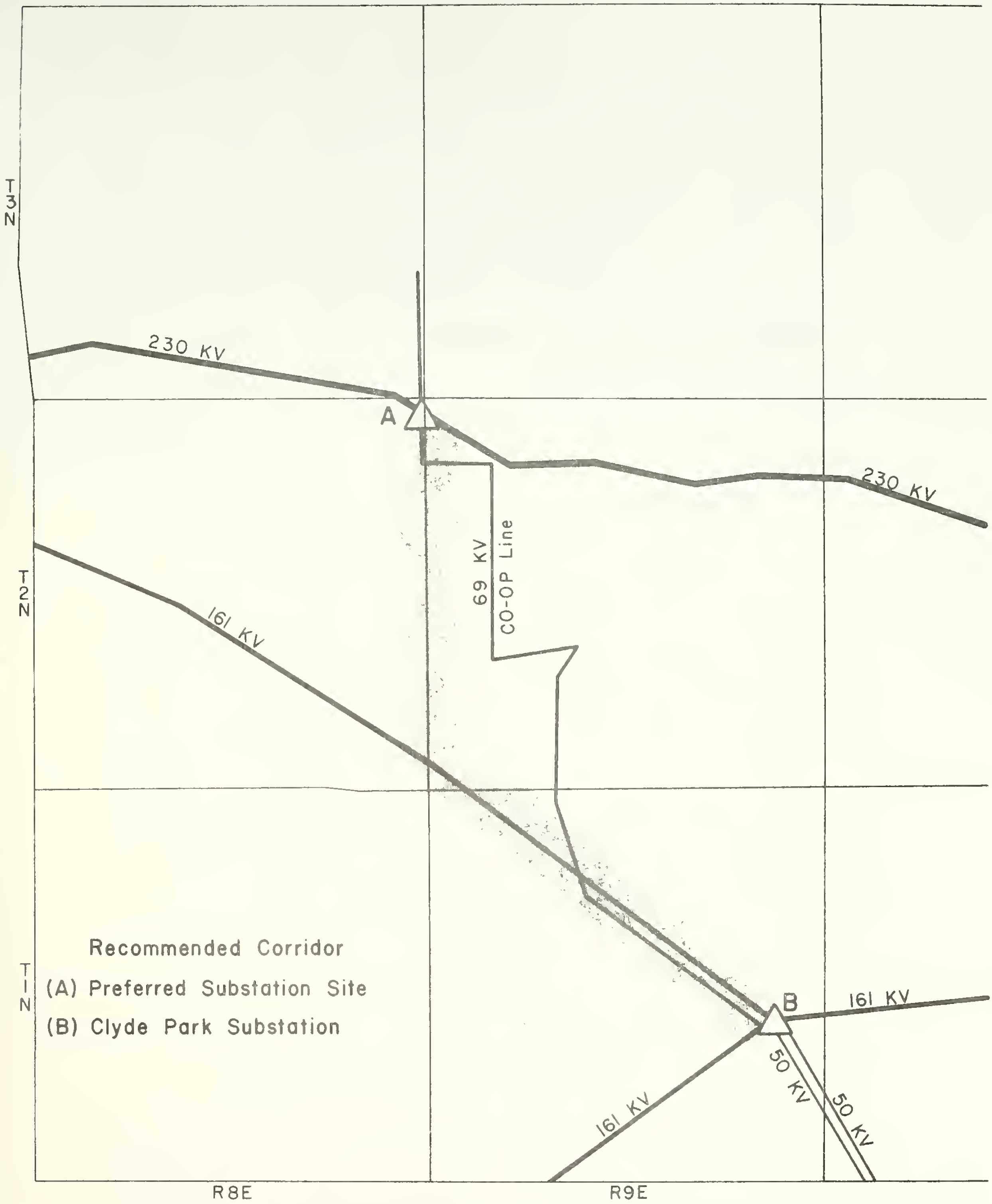
It is recommended that the application for the Wilsall-Clyde Park 161 KV transmission line be approved, conditioned with mitigating measures concerning construction activities. The engineering need analysis indicates that voltage drop problems exist in the study area and that the proposed line is the best alternative to correct these problems.

At this time the Department recommends a one mile corridor (see Figure V-1). Location of the centerline within the corridor should be subject to further approval by the Department under the condition that the applicant will work with local land owners in order to obtain a mutually agreeable centerline location.

The primary impact of the proposed line will be caused by construction and maintenance activities. The following construction guidelines will mitigate many of these adverse impacts and should be conditions in the certificate.

1) Road development should be limited to that amount absolutely required for the construction of the line and should be restricted to seasons in which construction can be completed with the least risk of introducing silt and sediment to area streams.

2) Where disturbance of the soil-vegetation systems takes place, re-seeding should be done at the next suitable season utilizing native plant species. A second attempt should be made to re-seed the area if the first effort fails.



Clyde Park–Wilsall 161 KV Transmission Line

RECOMMENDED CORRIDOR

Figure V–1

Hydroseeding, utilizing some binding material, must be undertaken for disturbed areas with slopes exceeding 15%.

3) Sediment traps should be constructed in any disturbed area exceeding 20,000 sq. ft. in size. There is a serious sedimentation problem in the study area, and this should help minimize the overall impact.

4) Poles should be placed at least 100 feet from intermittent or permanent streams.

5) Construction should be done when the soil is neither saturated nor subjected to periods of heavy rain.

6) Cultivated portions of the corridor area should be avoided by following existing fence lines to prevent interference with farming operations.

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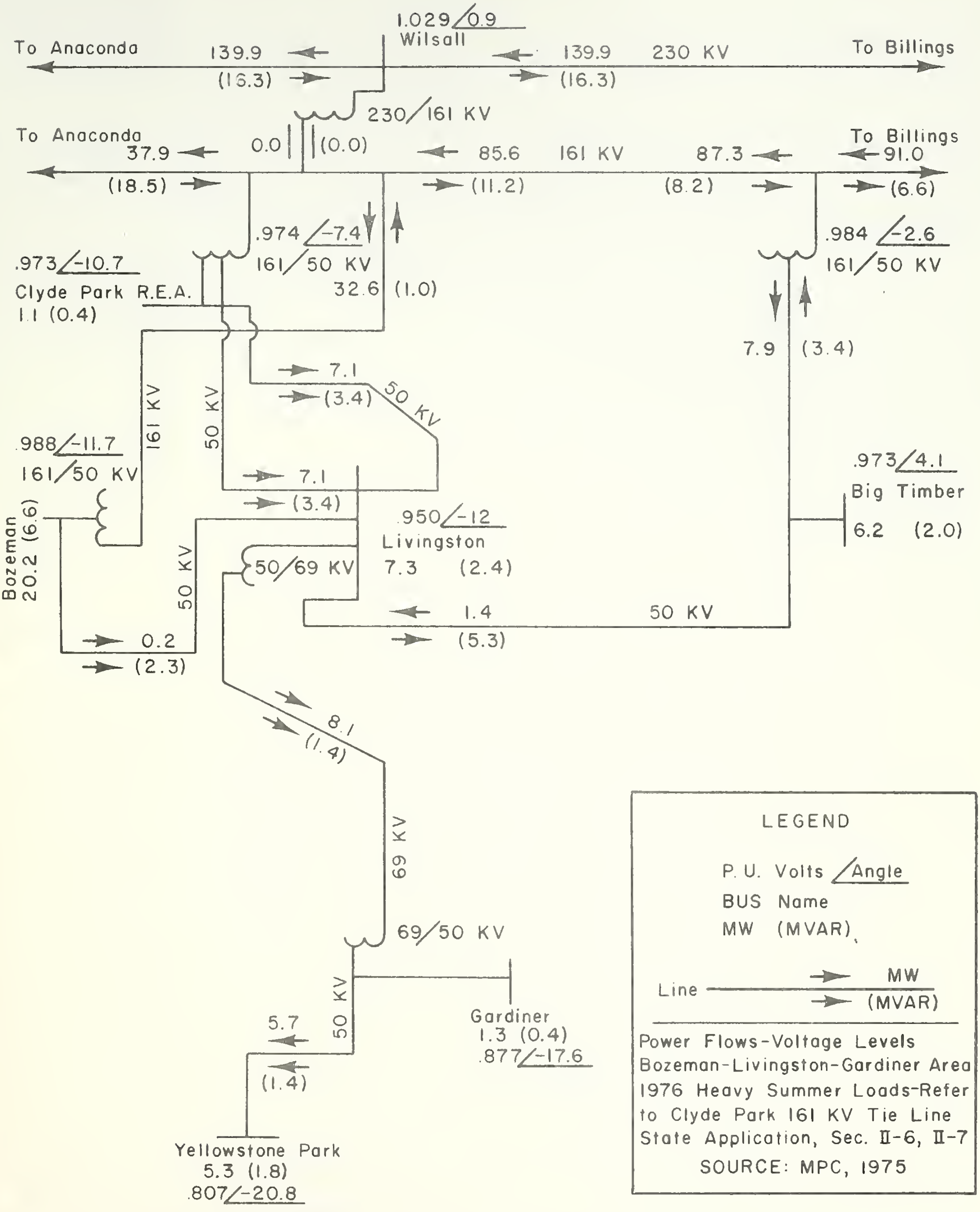
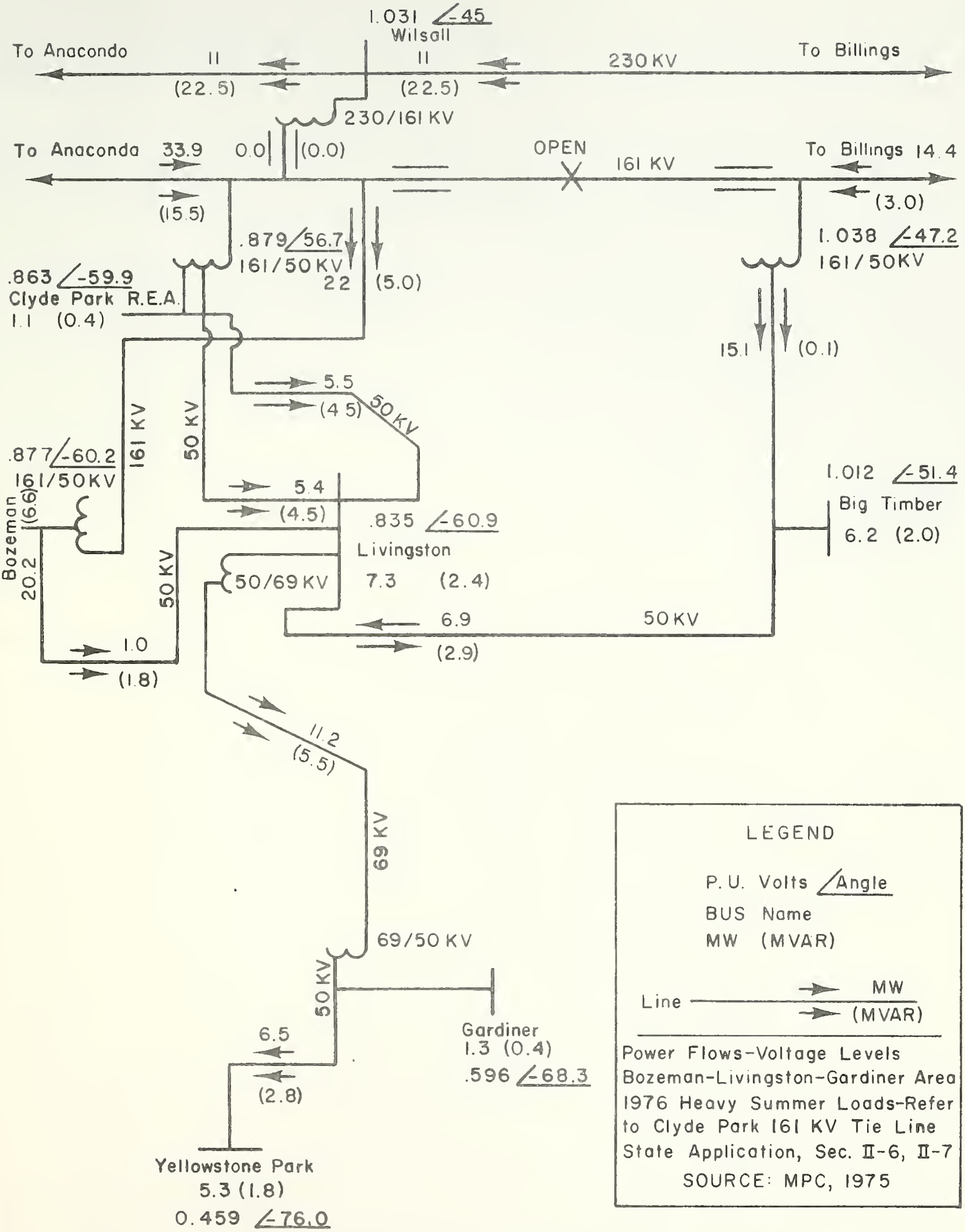
TECHNICAL APPENDIXES



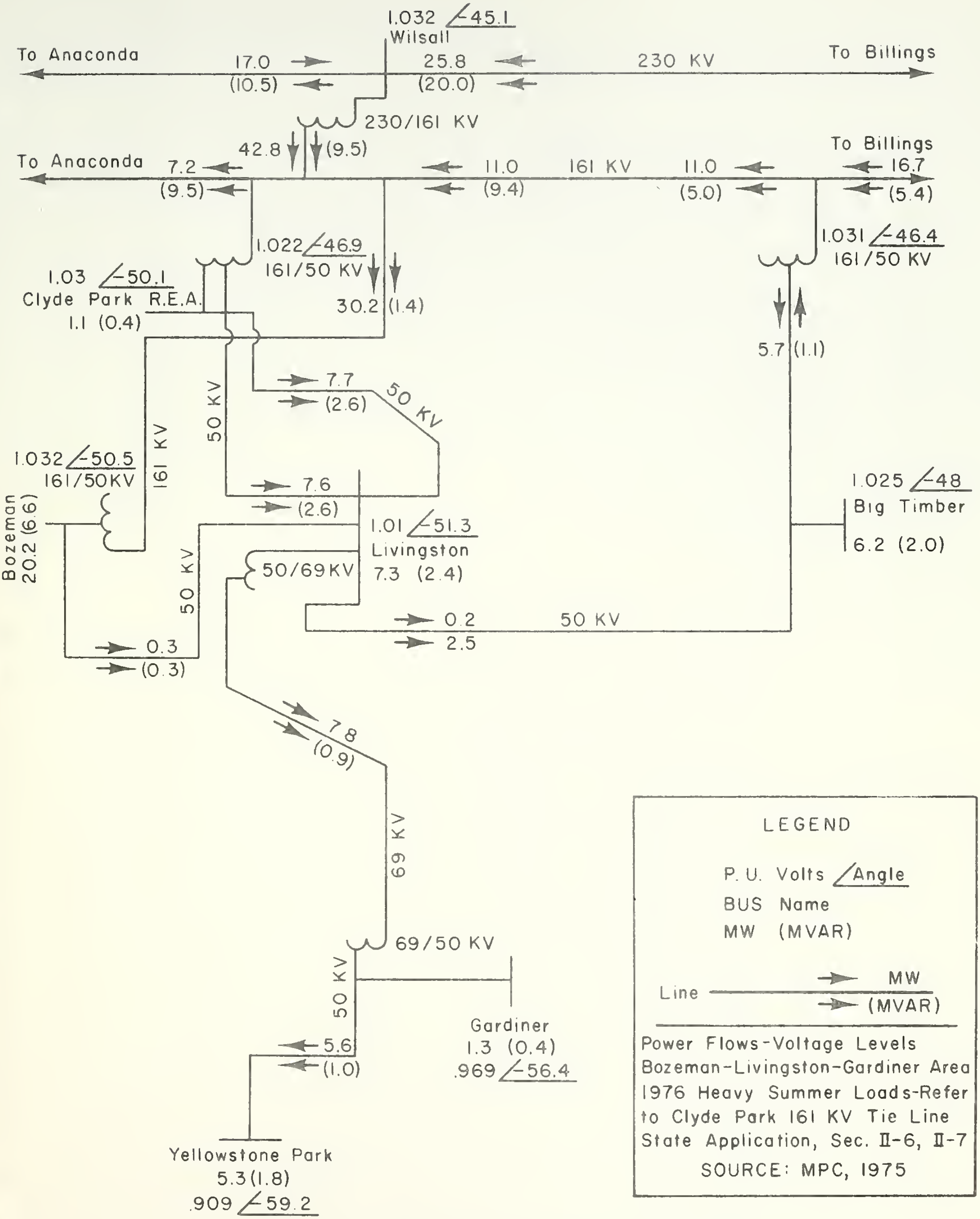
Power Flows-Voltage Levels
Bozeman-Livingston-Gardiner Area
1976 Heavy Summer Loads-Refer
to Clyde Park 161 KV Tie Line
State Application, Sec. II-6, II-7
SOURCE: MPC, 1975

NORMAL OPERATION EXISTING SYSTEM
(WITHOUT 161 KV TIE LINE)

Appendix A



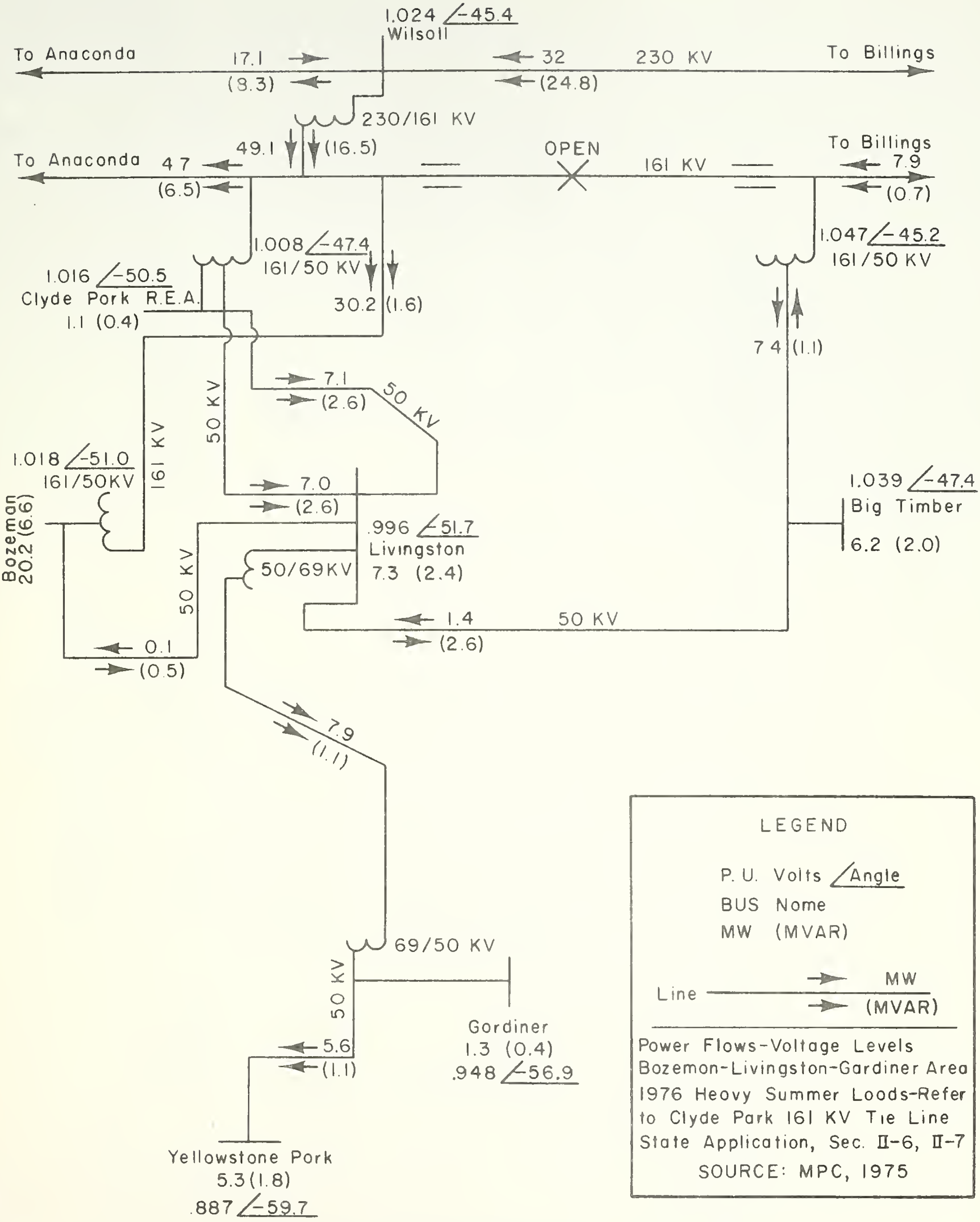
EXISTING SYSTEM CLYDE PARK-BIG TIMBER OUTAGE
(WITHOUT 161 KV TIE LINE)



Power Flows-Voltage Levels Bozeman-Livingston-Gardiner Area 1976 Heavy Summer Loads-Refer to Clyde Park 161 KV Tie Line State Application, Sec. II-6, II-7

SOURCE: MPC, 1975

NORMAL OPERATION EXISTING SYSTEM
WITH 161 KV TIE LINE



Power Flows-Voltage Levels
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EXISTING SYSTEM WITH 161 KV TIE LINE
& CLYDE PARK-BIG TIMBER OUTAGE

APPENDIX E

TABLE 1

Elk and Mule Deer Classification by Hunting Districts, 1972-1973 and 1973-1974[1]

DISTRICT NO.	SPECIES	SEASON	TOTAL CLASSIFIED	CLASSIFICATION	RATIO
312[2]	Elk	Winter '72-73	196	135 cows, 48 calves, 13 bulls	36 calves/100 cows
312	Mule deer	Winter '72-73	121	77 adults, 44 fawns	57 fawns/100 adults
312	Mule deer	Winter '73-74	173	112 adults, 61 fawns	54 fawns/100 adults
315	Elk	Winter '72-73	124	84 cows, 35 calves, 5 bulls	42 calves/100 cows
315	Elk	Winter '73-74	96	60 cows, 34 calves, 2 bulls	57 calves/100 cows
315	Mule deer	Winter '72-73	142	92 adults, 50 fawns	54 fawns/100 adults
315	Mule deer	Winter '73-74	154	93 adults, 61 fawns	66 fawns/100 adults

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[1] Source: Constan 1974

[2] Includes only that portion of hunting district 312 which lies within the Shields River drainage

APPENDIX E

TABLE 2

Deer Harvest Estimates by Hunting District, 1973-74[1]

DISTRICT	HUNTERS[2]		KILL[2]		HUNTER SUCCESS	AGE AND SEX			SPECIES		
	Point	Range	Point	Range	(%)	Ant-lered	Antler-less	Un-known	Mule deer	White-tails	Unclass-ified
312	5681	5510-5852	2566	2451-2681	45	1532	992	42	2316	143	107
315	2435	2324-2546	1177	1100-1254	48	728	438	11	1092	56	29

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[1] Figures presented are estimates, based on hunter questionnaires, furnished by the Montana Department of Fish and Game.

[2] Range indicates 95% confidence limits.

APPENDIX E

TABLE 3

Elk Harvest Estimates by Hunting District, 1973-74[1/]

DISTRICT	HUNTERS[2/]		KILL[2/]		HUNTER SUCCESS	AGE AND SEX					HUNTER DAYS
	Point	Range	Point	Range	(%)	Bull	Spike	Cow	Calf	Un-known	
312	1200	1136-1284	110	87-133	9	59	47	0	0	4	4711
315	562	508-616	61	42-80	11	36	11	0	0	14	2499

[1/] Figures presented are estimates, based on hunter questionnaires, furnished by the Montana Department of Fish and Game.

[2/] Range indicates 95% confidence limits.

APPENDIX E

TABLE 4

Antelope Harvest Estimates by Hunting District, 1973-74[1]

DISTRICT	NO. PERMITS	HUNTERS[2]		KILL[2]		HUNTER SUCCESS	SEX CLASS				AVERAGE DAYS HUNTED
		Point	Range	Point	Range	(%)	Male	Female	Fawn	Un-known	
338	20	19	18-19	12	10-13	63	8	4	0	0	2
339	130	130	-	78	-	60	45	30	4	0	3

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[1] Figures presented are estimates, based on hunter questionnaires, furnished by the Montana Department of Fish and Game.

[2] Range indicates 95% confidence limits.

APPENDIX E

TABLE 5 Waterfowl use of Cottonwood Reservoir and Stockponds during spring and fall, 1974[1]

Species	Cottonwood Reservoir										Stockponds		
											A[2]	B[3]	
	Mar 27	Apr 2	Apr 5	May 23	Oct 1	Oct 11	Oct 25	Oct 31	Nov 8	Nov 20	Oct 11	Oct 11	Oct 31
Western Grebe	-	-		28[4]	-	-	6	2	-	-	-	-	-
Pied-billed Grebe	-	-	-		-	20	-	-	-	-	2	-	-
Whistling Swan	72	72	-	-	-	-	-	-	15	8	-	-	-
Canada Goose	9	-	11	-	-	10	-	7	-	3	-	-	-
Mallard	40	25	250	5	-	90	370	300	58	292	3	7	137
Gadwall	-	-	-	4	200	-	-	-	-	-	-	-	35
Pintail	500	180	600	8	-	-	-	40	-	2	-	-	-
Green-winged teal	-	-	-	-	-	-	-	75	19	-	-	-	-
American Widgeon	4	15	150	12	-	-	-	-	-	-	-	-	-
Northern Shoveler	-	-	30	3	-	-	-	-	-	-	3	-	-
Redhead	-	-	-	2	-	-	-	-	-	-	-	-	-
Canvasback	-	-	35	2	12	10	-	-	-	-	6	-	-
Lesser Scaup	4	5	40	5	-	-	-	-	-	-	-	-	-
Common Goldeneye	3	-	25	-	-	-	-	2	-	8	-	-	-
Bufflehead	-	-	-	-	-	6	-	3	-	-	-	-	-
Ruddy Duck	-	-	-	-	-	28	-	6	-	-	-	-	-
Common Merganser	-	-	10	-	-	-	-	2	-	-	-	-	-
American Coot	-	-	-	225	165	75	1	-	-	-	8	-	-

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[1] Source: Hook (1974, 1975)
[2] Location S17, T2N, R9E
[3] Location S13, T3N, R8E
[4] Unclassified grebes

TABLE 6 Upland Game Bird Harvest, Wilsall Check Station[1/]

Year	Hunters	Total Birds	Sage Grouse	Sharp-tails	Ruffed Grouse	Blue Grouse	Gray Partridge	Birds/ Hunter
1963	120	155	117	3	-	11	24	0.9
1965	190	165	119	7	1	9	-	0.9
1966	169	173	114	9	12	16	-	1.0
1967	111	75	57	-	-	11	7	0.7
1968	72	66	53	1	-	6	6	0.9
1969*	75	93	45	2	-	37	9	1.2
	32	52	41	5	-	3	3	1.6
1970*	75	91	77	1	-	12	1	1.2
	26	24	21	-	-	-	3	0.9
1971*	38	55	36	5	-	14	-	1.5
	39	44	29	-	-	13	2	1.4
1972*	76	110	55	10	3	39	3	1.4
	21	19	12	2	-	5	-	0.9
1973	68	82	63	-	-	9	10	1.2

[1/] Source: Hook (1974)

* Years 1969 through 1972 include data from first two days of season.

TABLE 1 Shields River Drainage Electrofishing Stream Survey Data, 1974

Water	Section Length (ft)	Location			Estimated Flow (CFS)	Fish Species	Number Caught	Length Range (inches)	Average Size	Date
		T	R	S						
Shields River										
(Sec. 3)	200	1N	9E	13	200	Wf	80(79)	3.9 - 12.8	10.4	
				24		LL	2(2)	7.2 - 11.0	9.1	
						Ct	1(1)	9.1		8-27-74
						W Su	3(3)	12.4 - 14.1	13.5	
						J Su	58(33)	5.1 - 7.7	6.3	
						Ln D	1(0)	4.7		
(Sec. 4)	11,400	1N	9E	10	100	Wf	419(412)	4.1 - 16.8	10.2	
				11		LL	131(130)	3.7 - 20.1	12.1	
				14		Ct	6(6)	9.0 - 15.1	10.9	
						W Su	82(81)	3.9 - 18.9	15.2	9-04-74
						Ln Su	51(48)	5.6 - 19.3	15.4	
						J Su	1(1)	6.0		
						Rb x Ct	4(4)	8.6 - 10.8	9.8	
(Sec. 5)	300	2N	9E	21	100	Wf	33(33)	6.3 - 15.0	11.3	
						LL	6(6)	15.7 - 16.7	16.3	
						W Su	9(8)	3.6 - 15.5	12.3	8-27-74
						Ln Su	5(3)	4.0 - 18.5	12.7	
						Su	5(1)	4.1 - 6.4	5.6	
						Ln D	3(0)	2.9 - 3.8	3.4	
Antelope Cr.	150	2N	9E	8	2	W Su	1(1)	12.6		
						Ln Su	1(0)	4.0		8-01-74
						Lc	1(0)	4.7		
Cottonwood Cr.	450	2N	10E	7	25	Ct	4(2)	4.8 - 7.7	6.4	
(Sec. 1)						Rb	6(6)	4.6 - 11.1	7.7	8-13-74
						Rb x Ct	6(4)	4.3 - 8.9	7.1	
						LL	6(6)	8.1 - 12.8	9.5	
(Sec. 2)	1825	2N	10E	2	18	Ct	90(49)	3.4 - 11.4	6.2	
				3		Rb	16(14)	5.5 - 10.5	7.5	
						Rb x Ct	35(20)	3.9 - 9.1	6.3	10-11-74
						LL	46(34)	4.3 - 14.2	7.7	
						Eb	183(64)	2.7 - 9.1	5.5	
(Sec. 3)	500	3N	10E	24	25	Eb	1(1)	11.2		8-16-74

TABLE 1 (continued)

Water	Section Length (ft)	Location			Estimated Flow (CFS)	Fish Species	Number Caught	Length Range (inches)	Average Size	Date
		T	R	S						
Rock Cr.	150	2N	10E	30	10	Ct	2(2)	7.9 - 10.4	9.2	
(Sec. 1)						LL	27(23)	2.5 - 10.1	7.4	8-26-74
						Eb	14(12)	3.3 - 10.9	7.9	
(Sec. 2)	250	2N	10E	24	40	Ct	16(11)	3.9 - 10.8	6.6	8-26-74
						Eb	76(29)	2.4 - 9.2	5.5	
Brackett Cr.	500	1N	9E	4	21	Ct	6(6)	7.3 - 11.4	9.1	
(Sec. 1)						Rb	1(0)	5.2		
						LL	1(1)	16.7		
						Wf	28(16)	5.2 - 11.7	7.6	8-02-74
						W Su	1(1)	15.1		
						Ln Su	5(1)	3.3 - 6.4	4.9	
						J Su	1(0)	5.4		
(Sec. 2)	250	1N	8E	2	20	Ct	27(9)	3.4 - 9.4	5.3	
						LL	3(1)	2.8 - 14.1	7.1	8-01-74
						Wf	13(10)	2.6 - 12.3	9.9	
Canyon Cr.	250	1N	9E	14	5	Ct	1(1)	9.3		8-02-74
						LL	11(10)	5.7 - 13.1	10.7	
Bangtail Cr.	150	1N	9E	29	3	Ct	19(3)	3.2 - 9.0	4.8	8-02-74
						Eb	9(3)	2.8 - 7.9	5.4	

1/ Abbreviations used: Rb-rainbow trout; LL-brown trout; Ct-cutthroat trout; Eb-brook trout; Rb x ct-rainbow, cutthroat hybrids; Wf-mountain whitefish; Ln Su-longnose sucker; W Su-white sucker; Lc-lake chub; J Su-mountain sucker; Ln D-longnose dace.

2/ Figure in parenthesis is number of fish in sample greater than six inches in total length.

Source: Ellig, 1974

TABLE 2 ESTIMATED BROWN TROUT POPULATION IN A SECTION OF THE SHIELDS RIVER ABOVE WILSALL, 1967. (CONFIDENCE INTERVALS AT 95 PERCENT LEVEL)

Age Group	No./1,000 feet	No./Acre	Percent Total No.	Pounds/Acre
I	8	14	11.6	1
II	4	7	5.1	2
III	37	67	53.9	52
IV	19	33	27.2	35
V	1	2	1.3	3
VI	1	1	0.9	2
Total	70	124	100.0	95
Confidence Int. (±)	13	23		

Source: Wipperman and Elser, 1968

APPENDIX F

TABLE 3 AVERAGE CALCULATED TOTAL LENGTHS AT EACH ANNULUX FOR BROWN TROUT FROM THE SHIELDS RIVER, 1967

Age Group	Number	Avg. Size at Capture	Length at Annulus					
			1	2	3	4	5	6
I	30	5.8	3.2					
II	20	9.2	3.1	7.0				
III	66	12.5	3.3	7.3	10.8			
IV	41	15.2	3.4	6.9	10.2	13.5		
V	4	17.5	3.2	6.3	10.1	13.5	16.1	
VI	4	19.2	3.3	5.7	8.7	11.9	15.2	17.5
Average		11.8	3.3	7.0	10.5	13.4	15.6	17.5
1950 Average (Peters, 1964)			3.1	7.2	10.8	13.1		

Source: Wipperman and Elser, 1968

APPENDIX F

Table 4 Mortality Rates of Eyed Yellowstone Cutthroat Trout Eggs Planted in the Shields River

Station	Location (River miles above the mouth)	Max. turbidity (J.T.U.)*	Mortality (percent)
1	0.5	340	88.0
2	4.0	300	15.5
3	9.0	270	24.7
4	18.0	235	63.3
5	24.4	250	39.3
6	31.0	80	14.3

*Jackson Turbidity Units

Source: Elser and Marcoux, 1971

TABLE 5 1972 Population and Age Structure Estimates for Brown Trout and Mountain Whitefish in the Shiplet Section of the Shield River (80% Confidence Intervals are Shown in Parentheses).

Shiplet Section 11,600 ft.		Brown Trout			Mountain Whitefish	
	Age	Estimated No.	Estimated Wt.	Age	Estimated No.	Estimated Wt.
7/18/72	I	55.99	8.17	II	360.17	181.09
	II	109.17	76.76	III	500.45	390.98
	III	165.16	251.29	IV and older	50.48	61.18
	Total	330.32 (±103)	336.22 (±105)	Total[1]	911.10	633.25
				TOTAL	1114 (±357)	656 (±188)

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[1] Fish 2 years old and older

Source: Department of Fish and Game, unpublished data